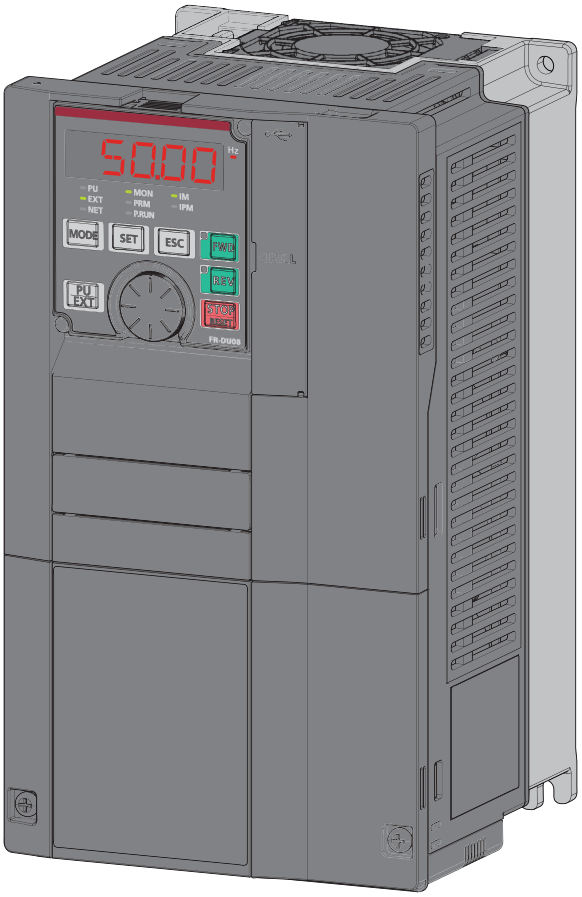
MITSUBISHI ELECTRIC

INVERTER

A800

PLC FUNCTION PROGRAMMING MANUAL



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◆About the related manuals

The manuals related to A800 PLC function are shown below. The download of the latest manuals is free at the Mitsubishi Electric FA Global Website.

Related manuals

Manual name	Manual number
FR-A800 Instruction Manual (Startup)	IB-0600493
FR-A800 Instruction Manual (Detailed)	IB-0600503ENG
FR Configurator2 Instruction Manual	IB-0600516ENG
GX Works2 Version 1 Operating Manual (Common)	SH-080779ENG

1 PLC Function

This instruction manual explains the functions and devices required for programming.

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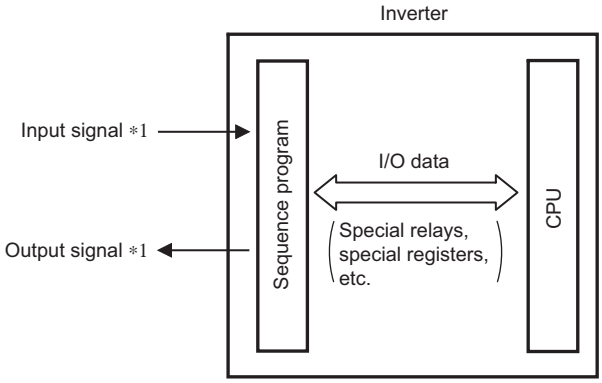
1.1 Applicable inverter model

This manual explains the PLC function of the FR-A800 series.

1.2 Function block diagram

The following function blocks explain I/O information flow to and from the inverter in the PLC function.

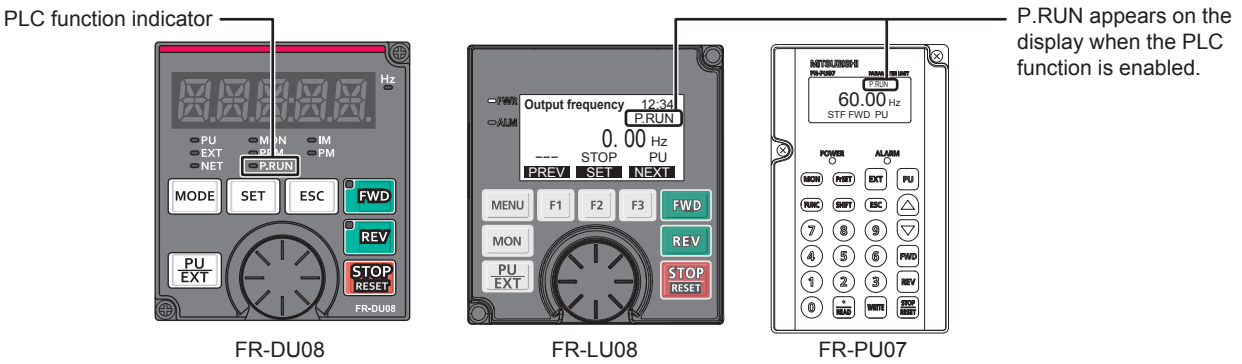
- I/O information can be read or written by accessing the inverter with special relays, special registers, etc. using predetermined methods.
- It is possible to operate the inverter and read and write parameters using input information from control input terminals according to created sequence programs (saved in the inverter).
  Output signals are also be output from control output terminals, not only as status signals of the inverter but as signals to turn the pilot lamp ON and OFF, interlock signals, and other control signals set by users as desired.



*1 Set "9999" in any of **Pr.178 to Pr.189 (input terminal function assignment)** and **Pr.190 to Pr.196 (output terminal function selection)** to use terminals as general-purpose I/O terminals. For details on **Pr.178 to Pr.189** and **Pr.190 to Pr.196**, refer to the Instruction Manual of the inverter.

1.3 Operation panel indication

When a sequence program is running, the following indicators are displayed on the operation panel and parameter unit.



P.RUN state

Indication		Status
FR-DU08 (LED)	FR-DU08 (LCD) FR-PU07 (LCD)	
Off	Normal indication	Sequence program stopped
On	Inverted indication	Sequence program running
Flickering	Inverted and flickering	Sequence error occurring

NOTE

- While the offline auto tuning is being activated by FR-PU07, P.RUN is not displayed even during PLC function operation.

1.4 PLC function specifications

The following table shows the program capacity and devices of the PLC function.

Item			A800 PLC function specifications
Control method			Repeated operation (by stored program)
I/O control mode			Refresh
Programming language			Relay symbolic language (ladder) Function block
No. of instructions	Sequence instructions		25
	Basic instructions		84
	Application instructions		37
Processing speed			Sequence instructions 1.9 µs to 12 µs/step*1
Number of I/O device points			128 (input: 64 points, output: 64 points) 19 points built-in (input: 12 points, output: 7 points)*2 FR-A8AX (input: 16 points) FR-A8AY (output: 6 points) FR-A8AR (output: 3 points)
Number of analog I/O points			3 input points built-in (Terminals 1, 2, and 4) 2 output points built-in (Terminals FM/CA and AM), FR-A8AY: 2 output points (AM0 and AM1)
Pulse train I/O		Input	Terminal JOG (maximum input pulse: 100k pulses/s) *3
		Output	Terminal FM (maximum output pulse: 50k pulses/s) *3
Watchdog timer			10 to 2000 ms
Program capacity			6K steps (24k bytes) (0 to 6144 steps can be set), contained in one program
Device	Internal relay (M)		128 (M0 to M127)
	Latch relay (L)		Not used (Can be set with parameters but will not latch)*4
	Timer (T)	Number of points	16 (T0 to T15)
		Specifications	100 ms timer: 0.1 to 3276.7 s can be set 10 ms timer: 0.01 to 327.67 s can be set 100 ms retentive timer: 0.1 to 3276.7 s can be set
	Counter (C)	Number of points	16 (C0 to C15)
		Specifications	Normal counter: Setting range 1 to 32767 Interrupt program counter: Not used
	Data register (D)		256 (D0 to D255)
	Special relay (SM)		2048 (SM0 to SM2047) with limited functions
	Special register (SD)		2048 (SD0 to SD2047) with limited functions

*1 The scan time is approximately 40 ms for 1K steps as inverter control is also performed in actual operations.

*2 The signals same as the ones assigned to the inverter I/O terminals are used.
One point is always required for a sequence start (RUN/STOP).

*3 The **Pr.291 Pulse train I/O selection** setting is required. The pulse train output is only available for the FM type inverter.

*4 There is no device latch function for power failures.
Use the **Pr.1150 to Pr.1199 PLC function user parameters 1 to 50** (D206 to D255) to store device values in the EEPROM. (Refer to **page 46**.)

NOTE

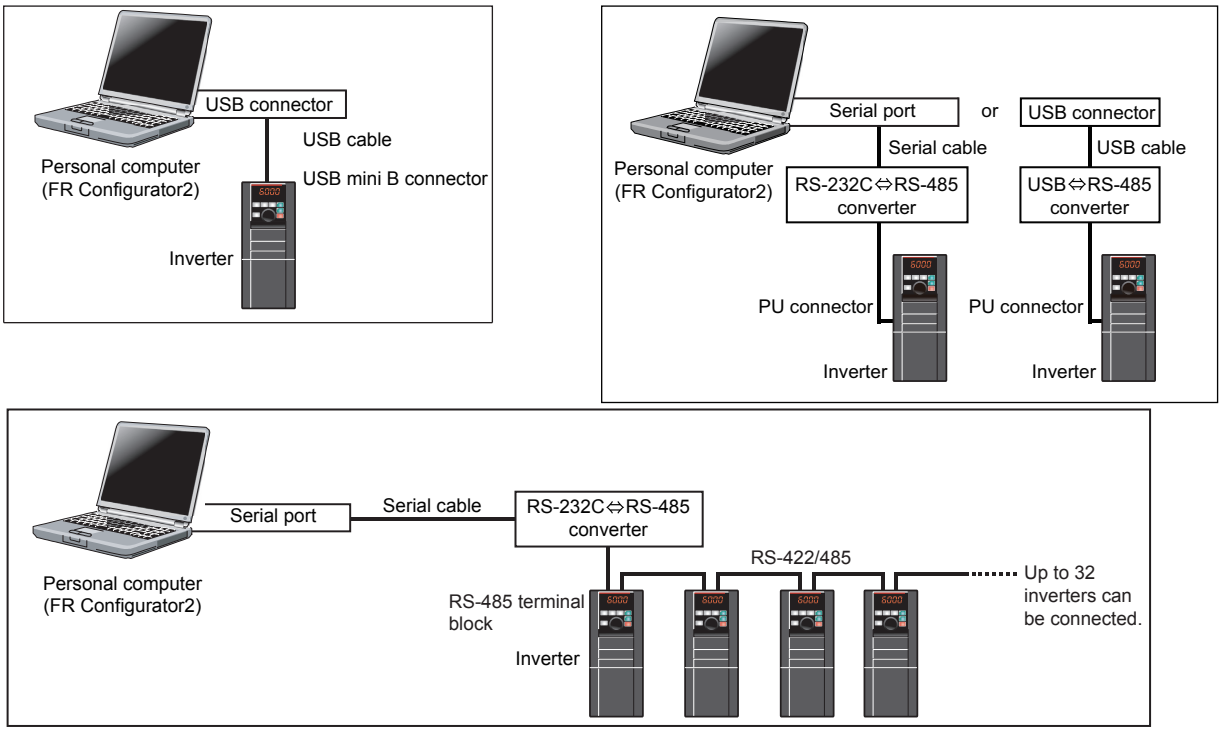
- There is no buffer memory.

1.5 System configuration

For writing sequence programs to the inverter, use FR Configurator2 (Developer) on the personal computer connected to the inverter via RS-485 communication. The inverter and the personal computer are connected via USB communication or RS-485 communication.

The following figure shows the system configuration for use of the PLC function.

<System configuration example>



Commercially available products (as of February 2012)

• RS-232C ⇔ RS-485 conversion cable

Model	Manufacturer
Interface embedded cable dedicated for inverter DINV-CABV *1	Diatrend Corp.

*1 The conversion cable cannot connect multiple inverters. (The computer and inverted are connected in a 1:1 pair.) This product is a RS-232C ⇔ RS-485 conversion cable that has a built-in converter. No additional cable or connector is required. For the product details, contact the manufacturer.

• USB ⇔ RS-485 conversion cable

Model	Manufacturer
DINV-U4	Diatrend Corp.

• Recommended USB cable for connection between the personal computer and the inverter

Model	Manufacturer
MR-J3USBCBL3M (cable length: 3 m)	Mitsubishi Electric Corporation

POINT

- FR Configurator2 (Developer) is a programming tool for designing and debugging of the sequence programs on the Windows personal computer. To use the PLC function of the inverter, write sequence programs to the inverter using FR Configurator2 (Developer). (For the details, refer to the Instruction Manual of FR Configurator2.)

NOTE

- For details on wiring, refer to the Instruction Manual of the inverter.
- For the specifications of the FR Configurator2 (Developer) and personal computers on which FR Configurator2 (Developer) runs, refer to the Instruction Manual of FR Configurator2.
- Programming tools other than FR Configurator2 (Developer) cannot be used. (Tools such as GX Developer and GX Works cannot be used.)

1.6 Operations of PLC function (Pr.414, Pr.415, Pr.498, Pr.1150 to Pr.1199)

I/O information can be read or written by accessing the inverter with special relays, special registers, etc. using predetermined methods.
It is possible to operate the inverter and read and write parameters using input information from control input terminals according to created sequence programs (saved in the inverter).
Output signals are also be output from control output terminals, not only as status signals of the inverter but as signals to turn the pilot lamp ON and OFF, interlock signals, and other control signals set by users as desired.

Parameter number	Name	Initial value	Setting range	Refer to page
414	PLC function operation selection	0	0 to 2	14
415	Inverter operation lock mode setting	0	0, 1	14
498	PLC function flash memory clear	0	0, 9696 (0 to 9999)	50
1150 to 1199	PLC function user parameters 1 to 50	0	0 to 65535	46

1.7 Prior to creating sequence programs

1.7.1 Precautions for creating sequence programs

POINT

- Writing and access to other stations are not possible while a sequence program is running.
  Also, reading and writing the program from and to other stations cannot be performed.
- To avoid accidentally erasing the created sequence programs, use FR Configurator2 (Developer) to regularly save the data in a personal computer, etc.

If a sequence program contains instructions (refer to page 106) or devices (refer to page 10) that cannot be used with the PLC function, an instruction code error occurs at the execution of that instruction.

Error code	SD0 = 4000
Error information	SD5 to SD26
Error flag	SM0: ON

NOTE

- For the error codes, refer to page 33.

1.7.2 The main functions of FR Configurator2 (Developer)

- Reading and writing parameter and sequence programs
- Ladder monitor
- Device batch monitor
- Present value change
- Remote RUN/STOP

NOTE

- Present values can be changed using FR Configurator2 (Developer) ([Debug] -> [Present value change]). Even if changes are made to the devices corresponding to the control terminal signals (STF, STR, etc.), such changes are not applied to the inverter operation. (Device present values of the sequence programs are changed.)

1.7.3 Sequence program execution

Parameter number	Name	Initial value	Setting range	Description	
414 *1	PLC function operation selection	0	0	PLC function disabled	
			1	PLC function enabled	The SQ signal is enabled by input from a command source (external input terminal/ communication).
			2		The SQ signal is enabled by input from an external input terminal
415	Inverter operation lock mode setting	0	0	The start signal of the inverter is enabled regardless of execution instruction of the sequence program.	
			1	The start signal of the inverter is enabled only when the sequence program is in RUN state. (The SQ signal is ON.) When the sequence program is in STOP state (the SQ signal is OFF), the inverter will not start even if the start signal STF or STR is turned ON. (If the state is changed from RUN to STOP during operation, the inverter decelerates and stops.)	

*1 Reset the inverter after configuring settings to enable the PLC function.

◆PLC function operation selection (Pr.414)

- To enable the PLC function, set "1" or "2" in **Pr.414 PLC function operation selection**. When **Pr.414** = "1", the command source for the sequence start (SQ) signal is determined by **Pr.338 Communication operation command source**. When "2" is set in **Pr.414**, SQ signal from the external input terminal is valid regardless of the setting of the **Pr.338**.
- Switch the execution key (RUN/STOP) of the sequence program by turning the SQ signal ON/OFF. The sequence program can be executed by turning the SQ signal ON. To input the SQ signal, set "50" in any of **Pr.178 to Pr.189 (input terminal function selection)** to assign the function to a terminal.
- Remote RUN/STOP of the PLC function can be executed in any of the following methods:
  - Using the PLC function parameters (contact)
  - Using FR Configurator2 (Developer)
  - Via CC-Link communication (refer to page 56.)

NOTE

- Turn OFF (STOP) the SQ signal when creating a sequence program.
- The RUN state output (Y) is internally stored and all outputs (Y) are turned off by turning the SQ signal OFF (STOP) after sequence program execution (SQ signal ON).
  The other devices retain the data prior to STOP. To clear the remaining device data, power OFF or reset (RES signal ON (0.1 s)→OFF) the inverter.

◆Inverter operation lock mode setting (Pr.415)

- When "1" is set in **Pr.415 Inverter operation lock mode setting**, the inverter can be operated only when the sequence program is set to the "RUN" status. By changing the PLC program status from RUN to STOP during inverter operation, the motor decelerates to stop.

POINT

- To run the inverter without using the PLC function, set **Pr.415** = "0" (initial value) (the start signal of the inverter is enabled).

NOTE

- This parameter cannot be written during inverter operation, regardless of the **Pr.77** setting.
- During automatic operation using SD1148 (or SM1200 to SM1211) in the sequence program, the inverter stops operation if the sequence program is in the STOP state while **Pr.415** = "1". However, when **Pr.415** = "0", the device data is retained and the operating status does not change (the inverter continues operation) even if the sequence program is in the STOP state.
- **Pr.415** setting is also enabled for the start signals of the operation panel.

1.7.4 Setting the communication parameter

POINT

- For RS-485 communication between the inverter and FR Configurator2, communication cannot be established when the inverter communication parameter settings and the FR Configurator2 communication settings differ.

- Set "9999" in **Pr.122 PU communication check time interval** for communication using the PU connector, and set "9999" in **Pr.336 RS-485 communication check time interval** for communication with RS-485 terminals.
- Use the same settings for the inverter communication parameters **(Pr.118 to Pr.120, Pr.124, Pr.332 to Pr.334, and Pr.341)** and the FR Configurator2 communication settings.
- Initial values are shown below.

Item	FR Configurator2 initial value	Inverter communication parameters		
		Pr.	Parameter name	Initial value
Communication speed	19200(bps)	118	PU communication speed	192 (19200 bps)
		332	RS-485 communication speed	96 (9600 bps)
Data length/Stop bit	Data length : 8 bits Stop bit : 2 bits	119	PU communication stop bit length / data length	1 (data length: 8 bits, stop bit: 2 bits)
		333	RS-485 communication stop bit length / data length	
Parity	Even	120	PU communication parity check	2 (with even parity check)
		334	RS-485 communication parity check selection	
Communication check time interval	-	122	PU communication check time interval	9999 (without communication check)
		336	RS-485 communication check time interval	0 (Changing to NET operation mode disabled)
Delimiter	CR	124	PU communication CR/LF selection	1 (CR)
		341	RS-485 communication CR/LF selection	

NOTE

- Use the operation panel to change the settings of the inverter parameters.
  The operation panel and FR Configurator2 (personal computer) cannot be connected to the PU connector simultaneously.
- For details on each inverter communication parameter, refer to the Instruction Manual (Detailed) of the inverter. For the setting method of the [Detailed setting] of the [System setting] window of FR Configurator2, refer to the Instruction Manual of FR Configurator2.
- Parameter clear/All parameter clear clears communication parameter settings and may disable the communication with FR Configurator2 (Developer).

1.7.5 Writing sequences programs

POINT

- Sequence programs can be written in any operation mode (External operation mode, PU operation mode and Network operation mode). For the operation modes, refer to **the Instruction Manual (Detailed)** of the inverter.

Check the following points when rewriting the PLC function parameters and sequence programs using FR Configurator2 (Developer):

- The sequence program execution status is in the STOP (SQ signal OFF) (refer to **page 14**).
- The inverter is stopped.
- The communication specifications setting parameters **(Pr.117 to Pr.124)** are correctly set. Communication with FR Configurator2 (Developer) is not possible if these parameter setting values are incorrect.
- The PLC series setting and sequence program capacity are correctly set with FR Configurator2 (Developer) parameters. (Refer to **page 11**.)

Refer to the FR Configurator2 manual and write sequence programs.

NOTE

- A sequence program cannot be written with its steps specified. The sequence program does not run if written in this way. (The program outside the specified range is initialized.)
- To read the PLC function parameters and sequence programs from the inverter, such information must be written to the inverter using FR Configurator2 (Developer) in advance. Always write the PLC function parameters and sequence program at least once as the inverter does not have valid data.
- There is a limitation on the number of times writing can be done (approximately 100,000 times) as the PLC function parameters and sequence program are written to the flash memory.
- A program with more than 6k steps (24k bytes) cannot be written.

1.8 Device map

1.8.1 I/O device map

	Device number	Name	Remarks	Device number	Name	Remarks
External input/output	X00	Terminal STF	External terminal	Y00	Terminal RUN	External terminal
	X01	Terminal STR		Y01	Terminal SU	
	X02	Terminal RH		Y02	Terminal IPF	
	X03	Terminal RM		Y03	Terminal OL	
	X04	Terminal RL		Y04	Terminal FU	
	X05	Terminal JOG		Y05	Terminal ABC1	
	X06	Terminal RT		Y06	Terminal ABC2	
	X07	Terminal AU		Y07	Empty (for temporary retention)	
	X08	Terminal CS		Y08		
	X09	Terminal MRS		Y09		
	X0A	Terminal STP (STOP)		Y0A		
	X0B	Terminal RES		Y0B		
	X0C	Vacant (for temporary retention)		Y0C		
	X0D			Y0D		
	X0E			Y0E		
	X0F			Y0F		
Plug-in option I/O	X10	Terminal X0	16 bits digital input FR-A8AX	Y10	Terminal DO0	Digital output FR-A8AY
	X11	Terminal X1		Y11	Terminal DO1	
	X12	Terminal X2		Y12	Terminal DO2	
	X13	Terminal X3		Y13	Terminal DO3	
	X14	Terminal X4		Y14	Terminal DO4	
	X15	Terminal X5		Y15	Terminal DO5	
	X16	Terminal X6		Y16	Terminal DO6	
	X17	Terminal X7		Y17	Terminal RA1	Relay output FR-A8AR
	X18	Terminal X8		Y18	Terminal RA2	
	X19	Terminal X9		Y19	Terminal RA3	
	X1A	Terminal X10		Y1A	Empty (for temporary retention)	
	X1B	Terminal X11		Y1B		
	X1C	Terminal X12		Y1C		
	X1D	Terminal X13		Y1D		
	X1E	Terminal X14		Y1E		
	X1F	Terminal X15		Y1F		

Device map

	Device number	Name	Remarks	Device number	Name	Remarks
System I/O	X20	Operation mode setting read complete	SD1140	Y20	Operation mode setting read command	SD1140
	X21	Set frequency read complete (RAM)	SD1141	Y21	Set frequency read command (RAM)	SD1141
	X22	Set frequency read complete (EEPROM)	SD1142	Y22	Set frequency read command (EEPROM)	SD1142
	X23	Operation mode setting write complete	SD1143	Y23	Operation mode setting write command	SD1143
	X24	Set frequency write complete (RAM)	SD1144	Y24	Set frequency write command (RAM)	SD1144
	X25	Set frequency write complete (EEPROM)	SD1145	Y25	Set frequency write command (EEPROM)	SD1145
	X26	Fault record batch clear complete	SD1146	Y26	Fault record batch clear command	SD1146
	X27	Parameter clear complete	SD1147	Y27	Parameter clear command	SD1147
	X28	Parameter read complete (RAM)	SD1241, SD1242, SD1234	Y28	Parameter read request (RAM)	SD1241, SD1242, SD1234
	X29	Parameter write complete (RAM)		Y29	Parameter write request (RAM)	
	X2A	Parameter read complete (EEPROM)	SD1243, SD1244, SD1235	Y2A	Parameter read request (EEPROM)	SD1243, SD1244, SD1235
	X2B	Parameter write complete (EEPROM)		Y2B	Parameter write request (EEPROM)	
	X2C	User parameter read complete (RAM)	D206 to D255 (**Pr.1150** to **Pr.1199**)	Y2C	User parameter read (RAM)	D206 to D255 (**Pr.1150** to **Pr.1199**)
	X2D	User parameter write complete (RAM)		Y2D	User parameter write (RAM)	
	X2E	User parameter read complete (EEPROM)		Y2E	User parameter read (EEPROM)	
	X2F	User parameter write complete (EEPROM)		Y2F	User parameter write (EEPROM)	
CC-Link I/O Remote I/O	X30	RY0	FR-A8NC	Y30	RX0	FR-A8NC
	X31	RY1		Y31	RX1	
	X32	RY2		Y32	RX2	
	X33	RY3		Y33	RX3	
	X34	RY4		Y34	RX4	
	X35	RY5		Y35	RX5	
	X36	RY6		Y36	RX6	
	X37	RY7		Y37	RX7	
	X38	RY8		Y38	RX8	
	X39	RY9		Y39	RX9	
	X3A	RYA		Y3A	RXA	
	X3B	RYB		Y3B	RXB	
	X3C	RYC		Y3C	RXC	
	X3D	RYD		Y3D	RXD	
	X3E	RYE		Y3E	RXE	
	X3F	RYF		Y3F	RXF	

1.8.2 Internal relay (M) device map

Device number	Description
M0 to M127	Available for users.

1.8.3 Data register (D) device map

Device number	Description	Refer to page
D0 to D205	Available for users.	-
D206 to D255	**Pr.1150 to Pr.1199** Parameters for user setting. Available for users.	**46**

1.8.4 Special relay

Special relay is an internal relay whose application is already determined in the PLC function. Therefore, do not turn ON/OFF the special relay in the program.

Device number	Name	Description
SM0	Diagnostic error	Turned ON when a diagnostic error has been detected. ON status is retained even after the condition becomes normal.
SM1	Self-diagnostic error	Turned ON when an error is detected by self diagnosis. ON status is retained even after the condition becomes normal.
SM5	Common error information	When SM5 is turned ON, common error information (SD5 to SD15) is stored.
SM16	Individual error information	When SM16 is turned ON, individual error information (SD16 to SD26) is stored.
SM56	Operation error flag	Turned ON when an operation error is detected during instruction execution. ON status is retained even after the condition becomes normal.
SM210	Clock data setting request	At OFF to ON of SM210, the clock data stored in SD210 to SD213 are written to the inverter.
SM211	Clock data error	Turned ON when the clock data (SD210 to SD213) has an error or is not a BCD value.
SM213	Clock data read request	Clock data is read and stored as BCD value in SD210 to SD213 when this relay is turned ON. The process is not executed when the relay is OFF.
SM400	Always ON	SM400 and SM401 are respectively turned ON and OFF regardless of the STOP and RUN statuses.
SM401	Always OFF	
SM402	ON only for one scan after RUN	SM402 and SM403 change depending on the STOP and RUN statuses. In the cases other than STOP: SM402 is ON only for one scan. SM403 is OFF only for one scan.
SM403	OFF only for one scan after RUN	
SM1200	Inverter operating status control flag (STF)	Flag used for controlling the inverter terminal STF.
SM1201	Inverter operating status control flag (STR)	Flag used for controlling the inverter terminal STR.
SM1202	Inverter operating status control flag (RH)	Flag used for controlling the inverter terminal RH.
SM1203	Inverter operating status control flag (RM)	Flag used for controlling the inverter terminal RM.
SM1204	Inverter operating status control flag (RL)	Flag used for controlling the inverter terminal RL.

Device map

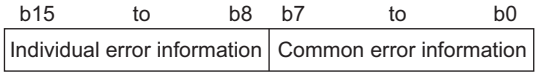
Device number	Name	Description
SM1205	Inverter operating status control flag (JOG)	Flag used for controlling the inverter terminal JOG.
SM1206	Inverter operating status control flag (RT)	Flag used for controlling the inverter terminal RT.
SM1207	Inverter operating status control flag (AU)	Flag used for controlling the inverter terminal AU.
SM1208	Inverter operating status control flag (CS)	Flag used for controlling the inverter terminal CS.
SM1209	Inverter operating status control flag (MRS)	Flag used for controlling the inverter terminal MRS.
SM1210	Inverter operating status control flag STP (STOP)	Flag used for controlling the inverter terminal STP (STOP).
SM1211	Inverter operating status control flag (RES)	Flag used for controlling the inverter terminal RES.
SM1216	Inverter status (RUN)	Inverter running
SM1217	Inverter status (FWD)	Forward rotation
SM1218	Inverter status (REV)	Reverse rotation
SM1219	Inverter status (SU)	Up to frequency
SM1220	Inverter status (OL)	Overload alarm
SM1221	Inverter status (IPF)	Instantaneous power failure/undervoltage
SM1222	Inverter status (FU)	Output frequency detection
SM1223	Inverter status (ALM)	Fault output
SM1224	Inverter status (LF)	Warning output
SM1225	Inverter status (DO0)	Stores the operating status of an output terminal function assigned by **Pr.313**.*1
SM1226	Inverter statusDO1)	Stores the operating status of an output terminal function assigned by **Pr.314**.*1
SM1227	Inverter status (DO2)	Stores the operating status of an output terminal function assigned by **Pr.315**.*1
SM1228	Inverter status (DO3)	Stores the operating status of an output terminal function assigned by **Pr.316**.*1
SM1229	Inverter status (DO4)	Stores the operating status of an output terminal function assigned by **Pr.317**.*1
SM1230	Inverter status (DO5)	Stores the operating status of an output terminal function assigned by **Pr.318**.*1
SM1231	Inverter status (DO6)	Stores the operating status of an output terminal function assigned by **Pr.319**.*1
SM1232	Inverter status (RA1)	Stores the operating status of an output terminal function assigned by **Pr.320**.*1
SM1233	Inverter status (RA2)	Stores the operating status of an output terminal function assigned by **Pr.321**.*1
SM1234	Inverter status (RA3)	Stores the operating status of an output terminal function assigned by **Pr.322**.*1
SM1235	Safety monitor (terminal SO)	The safety monitor (terminal SO) status is stored. This is turned ON when no internal safety circuit failure has occurred.
SM1255	Inverter operating status control selection	Select the inverter operating status of SM1200 to SM1211 and SD1148. OFF: Special relay selection ON: Special register selection
SM1256	2-word parameter access notice	Turned ON when parameter read for the inverter is executed using X28 to X2B, Y28 to Y2B, and the object was 2-word parameter. OFF: Read is completed as 1-word parameter. ON: Read is completed as 2-word parameter.

Device number	Name	Description
SM1257	2-word parameter access setting	Set the object as 2 word parameter when inverter parameter write is executed using X28 to X2B, Y28 to Y2B. OFF: Carries out writing as 1-word parameter. ON: Carries out writing as 2-word parameter.
SM1258	Clock data setting completion flag	Turned ON when the clock data is set using an external peripheral device, parameter, or SM210. This is turned OFF when SM213 is turned ON.

*1 Even if the FR-A8AY or FR-A8AR is not installed, **Pr.313 to Pr.322** are accessible during PLC function operation, and the operating status of the output terminal (virtual output terminal) function is stored in each device.

1.8.5 Special register

Special register is a data register in which the application is already determined in the PLC function. Therefore, do not write data into the special register on the program.

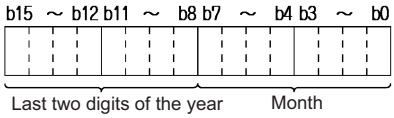
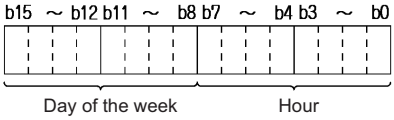
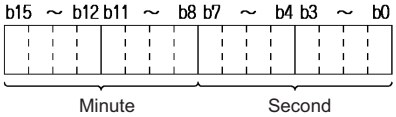
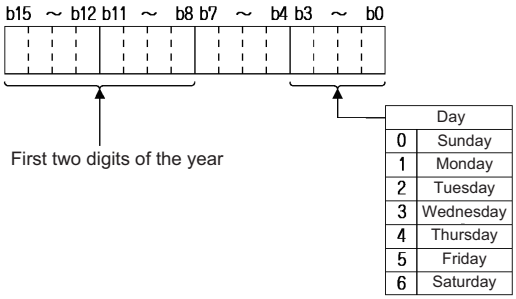
<table>
<tr><th colspan="2">Device number</th><th>Name</th><th>Description</th><th>Page</th></tr>
<tr><td rowspan="4">Special register</td><td>SD0</td><td>Self-diagnostic error</td><td>Error code is stored when an error is detected by self diagnosis.</td><td>33</td></tr>
<tr><td>SD4</td><td>Error information category</td><td>Stores the category codes that show the type of error information stored in the common information (SD5 to SD15) and the individual information (SD16 to SD26).
 

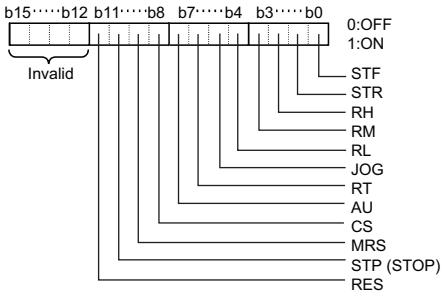
The following codes are stored in the common information category code.
<table><tr><th>Value</th><th>Code</th></tr><tr><td>0</td><td>Not used</td></tr><tr><td>2</td><td>File name/drive name</td></tr><tr><td>3</td><td>Time (setting value)</td></tr><tr><td>4</td><td>Program error location</td></tr></table>
The following codes are stored in the individual information category code.
<table><tr><th>Value</th><th>Code</th></tr><tr><td>0</td><td>Not used</td></tr><tr><td>3</td><td>Time (actual measurement value)</td></tr><tr><td>5</td><td>Parameter number</td></tr></table></td><td>-</td></tr>
<tr><td>SD5 to SD15</td><td>Common error information</td><td>When the common information category code is 2, the file name or drive name are stored in SD5 to SD11.
<table><tr><th>Number</th><th colspan="2">Description</th></tr><tr><td>SD5</td><td colspan="2">Drive name.</td></tr><tr><td>SD6</td><td rowspan="4">File name
(ASCII code: 8 characters)</td><td rowspan="4"></td></tr><tr><td>SD7</td></tr><tr><td>SD8</td></tr><tr><td>SD9</td></tr><tr><td>SD10</td><td>Extension</td><td>2EH(.)</td></tr><tr><td>SD11</td><td colspan="2">(ASCII code: 3 characters)</td></tr><tr><td>SD12 to SD15</td><td colspan="2">Empty</td></tr></table>The step numbers where errors occurred are stored in SD14 and SD15.</td><td>-</td></tr>
<tr><td>SD5 to SD15</td><td>Common error information</td><td>When the common information category code is 3, the time (setting value) is stored in SD5 and SD6.
<table><tr><th>Number</th><th>Description</th></tr><tr><td>SD5</td><td>Time: in 1 µs increments (0 to 999 µs)</td></tr><tr><td>SD6</td><td>Time: in 1 ms increments (0 to 65535 ms)</td></tr><tr><td>SD7 to SD15</td><td>Empty</td></tr></table></td><td>-</td></tr>
</table>

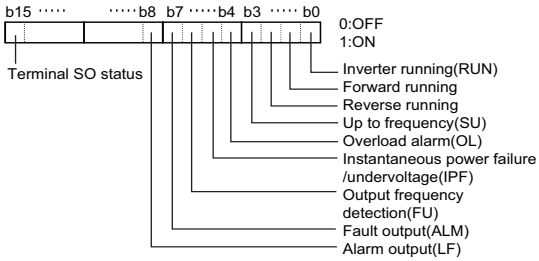
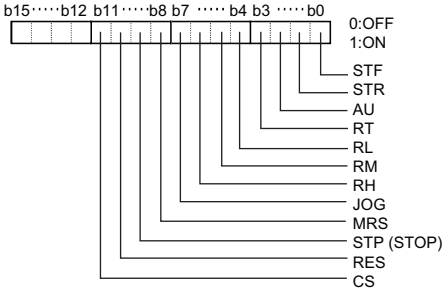
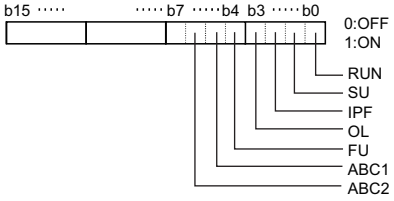
<table>
<tr><th colspan="2">Device number</th><th>Name</th><th>Description</th><th>Page</th></tr>
<tr><td rowspan="3">Special register</td><td>SD5 to SD15</td><td>Common error information</td><td>When the common information category code is 4, the program error location is stored in SD5 to SD15.
<table><tr><th>Number</th><th colspan="2">Description</th></tr><tr><td>SD5</td><td colspan="2" rowspan="4">File name MAIN *1
(ASCII code: 8 characters)</td></tr><tr><td>SD6</td></tr><tr><td>SD7</td></tr><tr><td>SD8</td></tr><tr><td>SD9</td><td>Extension</td><td>2EH(.)</td></tr><tr><td>SD10</td><td>QPG</td><td>(ASCII code: 3 characters)</td></tr><tr><td>SD11</td><td colspan="2">Always 0</td></tr><tr><td>SD12</td><td colspan="2">Always 0</td></tr><tr><td>SD13</td><td colspan="2">Always 0</td></tr><tr><td>SD14</td><td colspan="2" rowspan="2">Sequence step No.(L)
Sequence step No.(H)</td></tr><tr><td>SD15</td></tr></table>*1 Always "MAIN". After "MAIN", four space (20H) characters are stored.
The step numbers where errors occurred are stored in SD14 and SD15.</td><td>-</td></tr>
<tr><td>SD16 to SD26</td><td>Individual error information</td><td>When the individual information category code is 3, the time (actual measured data) is stored in SD16 and SD17.
<table><tr><th>Number</th><th>Description</th></tr><tr><td>SD16</td><td>Time: in 1 μs increments (0 to 999 μs)</td></tr><tr><td>SD17</td><td>Time: in 1 ms increments (0 to 65535 ms)</td></tr><tr><td>SD18 to SD26</td><td>Empty</td></tr></table></td><td>-</td></tr>
<tr><td colspan="2"></td><td>When the individual information category code is 5, the parameter number is stored in SD16.
<table><tr><th>Number</th><th>Description</th></tr><tr><td>SD16</td><td>Parameter number</td></tr><tr><td>SD17 to SD26</td><td>Empty</td></tr></table></td><td>-</td></tr>
<tr><td colspan="2">SD203</td><td>CPU module operating status</td><td>

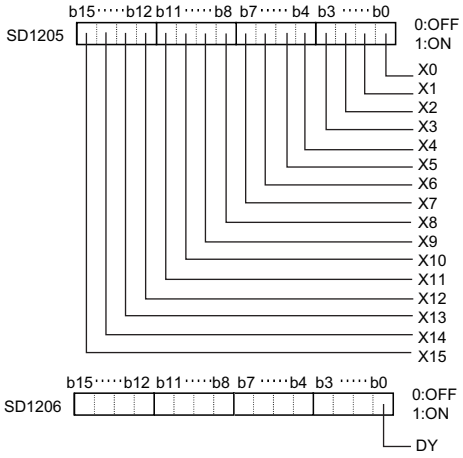
<table><tr><th>bit</th><th>Item</th><th>Value</th><th>Description</th></tr><tr><td>b3 to b0</td><td rowspan="2">CPU module operating status</td><td>0</td><td>RUN</td></tr><tr><td></td><td>1</td><td>STOP</td></tr><tr><td rowspan="4">b7 to b4</td><td rowspan="4">STOP/RUN factor</td><td>0</td><td>Switch</td></tr><tr><td>1</td><td>Remote contact</td></tr><tr><td>2</td><td>Remote operation from the peripheral S/W for the programmable controller</td></tr><tr><td>4</td><td>Error</td></tr></table></td><td>-</td></tr>
</table>

Device map

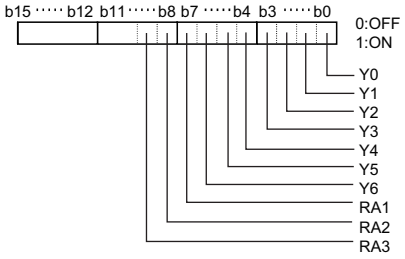
Device number		Name	Description	Page
Special register	SD210	Clock data	Year (the last two digits of the year) is stored in BCD code. 	-
	SD211	Clock data	Date and hour are stored in BCD code. 	-
	SD212	Clock data	Minute and second are stored in BCD code. 	-
	SD213	Clock data	Year (the first two digits of the year) and day of the week are stored in BCD code. 	-
	SD520	Current scan time	Scan time is stored at every END, and is constantly updated. (Measured in 100 µs increments) SD520: Stores the millisecond places (Stored range: 0 to 65535) SD521: Stores the microsecond places (Stored range: 0 to 900)	-
	SD521			-
	SD524	Minimum scan time	Minimum scan time is stored at every END. (Measured in 100 µs increments) SD524: Stores the millisecond places (Stored range: 0 to 65535) SD525: Stores the microsecond places (Stored range: 0 to 900)	-
	SD525			-
	SD526	Maximum scan time	Maximum scan time is stored at every END. (Measured in 100 µs increments) SD526: Stores the millisecond places (Stored range: 0 to 65535) SD527: Stores the microsecond places (Stored range: 0 to 900)	-
	SD527			-
	SD1062 to SD1093	Remote register	Special register for communicating with the master station in CC-Link.	57
	SD1133	Output frequency monitor	Present output frequency is stored. The increment is 0.01 Hz.	30
	SD1134	Output current monitor	Present output current is stored. The increment is 0.01 A.	
	SD1135	Output voltage monitor	Present output voltage is stored. The increment is 0.1 V.	

Device number		Name	Description	Page
Special register for control	SD1136	Faults history 1, 2	Faults in the inverter are stored in the order of occurrence.	31
	SD1137	Faults history 3, 4		
	SD1138	Faults history 5, 6		
	SD1139	Faults history 7, 8		
	SD1140	Operation mode setting read	Stores the present operation mode.	34
	SD1141	Set frequency read (RAM)	Reads and stores the set frequency (RAM).	35
	SD1142	Set frequency read (EEPROM)	Reads and stores the set frequency (EEPROM).	35
	SD1143	Operation mode setting write	Sets the operation mode to be changed.	37
	SD1144	Set frequency write (RAM)	Sets the running frequency (RAM).	37
	SD1145	Set frequency write (EEPROM)	Sets the running frequency (EEPROM).	38
	SD1146	Fault record batch clear	Clears the faults history when H9696 is written.	39
	SD1147	Parameter clear	H9696 write: parameter clear H9966 write: all clear H5A5A write: parameter clear except for communication parameters H55AA write: all clear except for communication parameters While communicating with FR Configurator2, clear the parameters using H5A5A or H55AA.	39
	SD1148	Inverter operating status control	Turn ON/OFF the corresponding bit to control the inverter operating status. All initial values are set as "0". When SM1255 is OFF, this function is disabled. 	40
	SD1149	Inverter operating status control enable/disable setting	The inverter operating status control by SD1148 and SM1200 to SM1211 can be enabled/disabled by turning ON/OFF the corresponding bit. The bit table is the same as SD1148. All initial values are set to "0" (invalid). Input through external terminals is always enabled for the SQ signal. (The SQ signal cannot be controlled with SD1149 bits.)	41
	SD1150	Inverter parameter access error	Stores the error number generated when parameter or data stored in the special register was not successfully reflected to the inverter.	42

Device number		Name	Description	Page
Special register for control	SD1151	Inverter status	Operating status of the inverter is stored. 	42
	SD1152	Frequency setting value	0.01 Hz increments	-
	SD1153	Running speed	1 (0.1) r/min increments **Pr.811 Set resolution switchover** enables 0.1 r/min unit indication	-
	SD1154	Motor torque	0.1% increments	-
	SD1155	Converter output voltage	0.1 V increments	-
	SD1156	Regenerative brake duty	0.1% increments	-
	SD1157	Electric thermal relay load factor	0.1% increments	-
	SD1158	Output power peak value	0.01 A increments	-
	SD1159	Converter output voltage peak value	0.1 V increments	-
	SD1160	Input power	0.01 kW increments	-
	SD1161	Output power	0.01 kW increments	-
	SD1162	Input terminal status	Details of input terminal status 	-
	SD1163	Output terminal status	Details of output terminal status 	-
	SD1164	Load meter	0.1% increments	-
	SD1165	Motor excitation current	0.01 A increments	-
	SD1166	Position pulse	Stores the encoder position pulse	-
	SD1167	Cumulative energization time	1 hour increments	-
	SD1169	Orientation status	Stores the orientation status.	-
	SD1170	Actual operation time	1 hour increments	-
	SD1171	Motor load factor	0.1% increments	-
	SD1172	Cumulative power	1 kWh increments	-
	SD1173	Position command (lower 16 bits)	Stores the position command setting value (lower 16 bits).	-

Device number		Name	Description	Page
Special register for control	SD1174	Position command (upper 16 bits)	Stores the position command setting value (upper 16 bits).	-
	SD1175	Feedback pulse (lower 16 bits)	Stores the feedback pulse value (lower 16 bits).	-
	SD1176	Feedback pulse (upper 16 bits)	Stores the feedback pulse value (upper 16 bits).	-
	SD1177	Droop pulse (lower 16 bits)	Stores the droop pulse value (lower 16 bits).	-
	SD1178	Droop pulse (upper 16 bits)	Stores the droop pulse value (upper 16 bits).	-
	SD1179	Torque command	0.1% increments	-
	SD1180	Torque current command	0.1% increments	-
	SD1181	Motor output	0.1 kW increments	-
	SD1182	Feedback pulse	Stores the feedback pulse quantity.	-
	SD1184	Station number (PU connector)	Stores the station number (PU connector).	-
	SD1185	Station number (RS-485 terminal block)	Stores the station number (RS-485 terminal block).	-
	SD1186	Communication station number (CC-Link)	Stores the communication station number (CC-Link).	-
	SD1187	Remote output 1	Stores the analog remote output setting value 1.	-
	SD1188	Remote output 2	Stores the analog remote output setting value 2.	-
	SD1189	Remote output3	Stores the analog remote output setting value 3.	-
	SD1190	Remote output 4	Stores the analog remote output setting value 4.	-
	SD1191	PTC thermistor resistance value	Stores the PTC thermistor resistance value.	-
	SD1197	Energy saving effect	According to the parameter settings.	-
	SD1198	Cumulative energy saving		-
	SD1199	PID set point	Stores the PID set point. The increment is 0.1%.	-
	SD1200	PID measured value	Stores the PID measured value. The increment is 0.1%.	-
	SD1201	PID deviation	Stores the PID deviation. The increment is 0.1%.	-
	SD1202	Second PID set point	Stores the second PID set point. The increment is 0.1%.	-
	SD1203	Second PID measured value	Stores the second PID measured value. The increment is 0.1%.	-
	SD1204	Second PID deviation	Stores the second PID deviation. The increment is 0.1%.	-
	SD1205	Option input terminal status 1	Stores the input status of the FR-A8AX. All are OFF (0) when there are no options installed. 	-
	SD1206	Option input terminal status 2		-

Device map

Device number		Name	Description	Page
Special register for control	SD1207	Option output terminal status	Stores the output status of the FR-A8AY or FR-A8AR. All are OFF (0) when there are no options installed. 	-
	SD1211	Dancer main speed setting	Stores the dancer main speed setting.	-
	SD1212	PID manipulated amount	Stores the PID manipulated amount. The increment is 0.1%.	-
	SD1213	PID measured value 2	Stores the PID measured value. The increment is 0.1%. (Monitoring can be performed even when PID control is disabled.)	-
	SD1214	User definition error	An inverter fault is initiated by setting the values of "16 to 20" in SD1214.	**43**
	SD1215	Monitor setting selection	Set SD1215 to display the monitor set in SD1216 to SD1218.	**43**
	SD1216	Monitor 1 setting value	The first to the third monitors on the operation panel can be changed by setting the value "40 to 42" in **Pr.774 to Pr.776.**	**43**
	SD1217	Monitor 2 setting value		
	SD1218	Monitor 3 setting value		
	SD1220	Motor thermal load factor	Stores the motor thermal load factor.	-
	SD1221	Inverter thermal load factor	Stores the inverter thermal load factor.	-
	SD1222	Second PID manipulated amount	Stores the second PID manipulated amount. The increment is 0.1%.	-
	SD1223	Second PID measured value 2	Stores the second PID measured value. The increment is 0.1%. (Monitoring can be performed even when PID control is disabled.)	-
	SD1224	32-bit cumulative power (Lower 16 bits)	1 kWh	-
	SD1225	32-bit cumulative power (Upper 16 bits)	1 kWh	-
	SD1226	32-bit cumulative power (Lower 16 bits)	0.01 kWh/0.1 kWh *2	-
	SD1227	32-bit cumulative power (Upper 16 bits)	0.01 kWh/0.1 kWh *2	-
	SD1229	Trace status	Stores the trace status.	-
	SD1234	Second parameter change (RAM)	When setting a calibration parameter (bias/gain) H00: Frequency (torque) H01: Analog value set by parameters H02: Analog value input from terminals	**44**, **45**
	SD1235	Second parameter change (EEPROM)		

*2 Settings differ according to the inverter capacity. (FR-A820-03160(55K) or lower and FR-A840-01800(55K) or lower, FR-A820-03800(75K) or higher and FR-A840-02160(75K) or higher)

Device number		Name	Description	Page
Special register for control	SD1236	Pulse train input sampling pulse	The number of pulses counted in count cycle is stored. (0 to 32767)	48
	SD1237	Pulse train input cumulative count value L	The cumulative value of the number of sampling pulses is stored. (0 to 99999999)	
	SD1238	Pulse train input cumulative count value H		
	SD1239	Reset request of pulse train input count	The sampling pulses and cumulative count value are cleared. Automatically changes to "0" after reset. (1: count clear)	
	SD1240	Count start of the pulse train input	Start counting the sampling pulses and cumulative count value. (0: count stop, 1: count start)	
	SD1241	Parameter number (RAM)	Set the parameter number to read from/write to the inverter.	44, 45
	SD1242	Parameter detail (RAM)	Stores the inverter parameter content (RAM value) specified by SD1241. Input the parameter setting value when writing the parameters.	
	SD1243	Parameter number (EEPROM)	Set the parameter number to read from/write to the inverter.	
	SD1244	Parameter content (EEPROM)	Stores the inverter parameter content (EEPROM value) specified by SD1243. Input the parameter setting value when writing the parameters.	
	SD1245	Terminal 1 input	Stores the analog input value (0.1% increments) to terminal 1.	47
	SD1246	Terminal 2 input	Stores the analog input value (0.1% increments) to terminal 2.	
	SD1247	Terminal 4 input	Stores the analog input value (0.1% increments) to terminal 4.	
	SD1248	PID control set point/ deviation	Set the PID set point or PID deviation. (0.01% increments)	49
	SD1249	PID control measured value	Set the PID measured value. (0.01% increments)	
	SD1250	PID control manipulated amount	Stores the PID manipulated amount. (0.01% increments)	
	SD1251	Terminal FM/CA output	When **Pr.54**="70", analog output can be performed from the terminal FM/CA. (0.1% increments)	47
	SD1252	Terminal AM output	When **Pr.158**= "70", analog output can be performed from terminal AM. (0.1% increments)	
	SD1253	AM0 output	Analog output can be performed from terminals AM0 and AM1 of the FR-A8AY. (0.1% increments)	
	SD1254	AM1 output		
	SD1255	PID operation control	Sets the start/stop of PID operation. Set "1" to start PID control.	49
	SD1308	Second PID control set point/deviation	Set the second PID set point or the second PID deviation. (0.01% increments)	
	SD1309	Second PID control measured value	Set the second PID measured value. (0.01% increments)	
	SD1310	Second PID control manipulated amount	Stores the second PID manipulated amount. (0.01% increments)	
	SD1320	Read parameter content (2-word parameter: L)	When the parameter to be written is 2 words, storage locations are as follows: SD1320: Lower 1 word SD1321: Upper 1 word	-
	SD1321	Read parameter content (2-word parameter: H)		-
	SD1322	Write parameter content (2-word parameter: L)	When the parameter to be read is 2 words, storage locations are as follows: SD1322: Lower 1 word SD1323: Upper 1 word	-
	SD1323	Write parameter content (2-word parameter: H)		-

1.9 Special registers to monitor and control inverter status

Read from and write to user sequences are possible by assigning the data to monitor and change the operating status of the inverter from SD1133 to SD1147. (For the list of registers, refer to page 22.)

1.9.1 Always readable data

The following data is always readable. They are refreshed on every END instruction automatically.

◆Operation monitor

These are the data devices by which the output frequency, output current, and output voltage of the inverter can be monitored, and which are always readable (write is disabled). Pay attention to the setting increments.

Device number	Name	Setting increments	Data example	Data access condition
SD1133	Output frequency monitor	0.01 Hz	Device content 6000→60.00 Hz	Always accessible
SD1134	Output current monitor	0.01 A	Device content 200→2.00 A	
SD1135	Output voltage monitor	0.01 V	Device content 1000→10.0 V	

NOTE

- Setting frequency can be set in increments of 0.01 Hz, but operates at 0.1 Hz increments in actual operation.

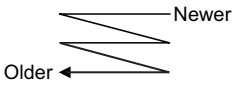
◆Faults history (error code and error definition)

When the inverter fails, it stores error codes.

A maximum of eight faults are stored with error codes in the order shown below, and they are always readable (write is disabled).

<Error code storing method details>

	b15 to b8	b7 to b0
SD1136	Faults history 2	Faults history 1
SD1137	Faults history 4	Faults history 3
SD1138	Faults history 6	Faults history 5
SD1139	Faults history 8	Faults history 7



Error code	Fault record
H00	No failure
H10	E.OC1
H11	E.OC2
H12	E.OC3
H20	E.OV1
H21	E.OV2
H22	E.OV3
H30	E.THT
H31	E.THM
H40	E.FIN
H50	E.IPF
H51	E.UVT
H52	E.ILF
H60	E.OLT
H61	E.SOT
H70	E.BE

Error code	Fault record
H80	E.GF
H81	E.LF
H90	E.OHT
H91	E.PTC
HA0	E.OPT
HA1	E.OP1
HA4	E.16
HA5	E.17
HA6	E.18
HA7	E.19
HA8	E.20
HB0	E.PE
HB1	E.PUE
HB2	E.RET
HB3	E.PE2
HC0	E.CPU
HC1	E.CTE

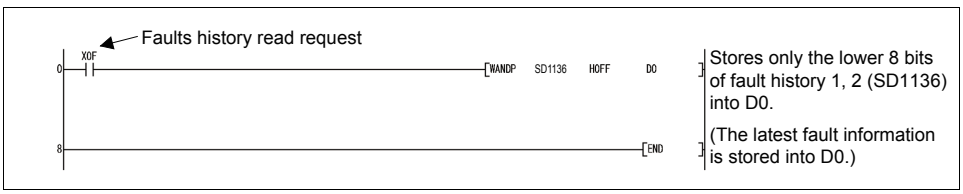
Error code	Fault record
HC2	E.P24
HC4	E.CDO
HC5	E.IOH
HC6	E.SER
HC7	E.AIE
HC8	E.USB
HC9	E.SAF
HCA	E.PBT
HD0	E.OS
HD1	E.OSD
HD2	E.ECT
HD3	E.OD
HD5	E.MB1
HD6	E.MB2
HD7	E.MB3
HD8	E.MB4
HD9	E.MB5

Error code	Fault record
HDA	E.MB6
HDB	E.MB7
HDC	E.EP
HE1	E.IAH
HE4	E.LCI
HE5	E.PCH
HE6	E.PID
HF1	E.1
HF2	E.2
HF3	E.3
HF5	E.5
HF6	E.6
HF7	E.7
HFB	E.11
HFD	E.13

For details of fault records, refer to the Instruction Manual of the inverter.

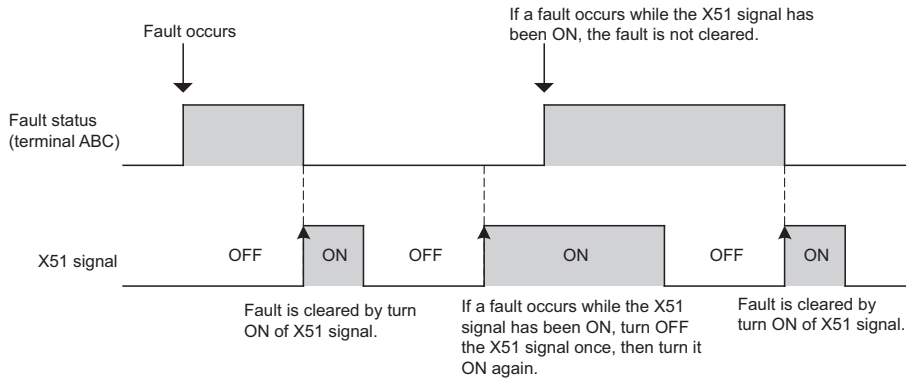
<Program example for reading a fault record>

The following description is of a program that reads out the latest fault record of the inverter and stores to D0.



◆Fault clear signal (X51 signal)

When an inverter fault occurs, X51 signal clears the fault without resetting the inverter.
By using the X51 signal, the inverter fault can be cleared with the PLC function still operating.
Set "51" in **Pr.178 to Pr.189 (Input terminal function selection)** in advance to enable the X51 signal.


Fault occurs
If a fault occurs while the X51 signal has been ON, the fault is not cleared.
Fault status (terminal ABC)
X51 signal
OFF
ON
OFF
ON
OFF
ON
Fault is cleared by turn ON of X51 signal.
If a fault occurs while the X51 signal has been ON, turn OFF the X51 signal once, then turn it ON again.
Fault is cleared by turn ON of X51 signal.

- The fault clear function using the X51 signal does not function while the retry function is operating (including during the retry waiting time).
  (The X51 signal operates when the retry count is exceeded (E.RET).
- When the fault is cleared, start commands from PU and communication are also cleared. (All commands except the start command from communication are maintained in the status before the fault is cleared.)

NOTE

- E.CPU, E.P24, E.CTE, E.1 to E.3, E.5 to E.7, E.13, E.16 to E.20, E.SAF and E.PE2 are not cleared by X51 signal.
- When a fault is cleared, the accumulated heat values of the electronic thermal O/L relay and regenerative brake are not cleared. Faults including E.THM, E.THT, and E.BE may occur again.
- The inverter remains in the stop status immediately after a fault is cleared. However, the inverter starts operating again after the fault is cleared if the start command is ON.
- When an error occurs, the normal reset function operates when the STOP/RESET key on the operation panel or parameter unit is pushed. Be careful not to push the key by mistake.
- Changing terminal assignment by using **Pr.178 to Pr.189 (input terminal function selection)** may affect the other functions. Set parameters after confirming the function of each terminal.

◆Self-diagnostic error, error number and details

When an operation error occurs during execution of sequence programs, the following error numbers are stored in SD0.
When a self-diagnostic error occurs, the "P.RUN" indicator (LED) blinks.

Error No.	Error name	Details
1010	END NOT EXECUTE	END command was not executed.
2200	MISSING PARA.	No parameter file.
2502	CAN'T EXE.PRG	The program file is not correct. Or the content of the file is not a program.
3000	PARAMETER ERR	The content of the parameter indicated by the individual error information (SD16) is incorrect.
3003	PARAMETER ERR	The number of device points set in the PLC parameter device setting is not within the usable range.
4000	INSTRCT. CODE ERR	An undecodable instruction code is included in the program. An unusable instruction is included in the program.
4010	MISSING END INS.	No END (FEND) instruction in the program.
4100	OPERATION ERROR	Data that cannot be used in instructions is included.
5001	WDT ERROR	The program scan time exceeded the watchdog timer value set in the PLC RAS setting of the PLC parameter.
5010	PRG.TIME OVER	The program scan time exceeded the constant scan time set in the PLC RAS setting of the PLC parameter.

NOTE

- Operation at error stop
  Output (Y) is cleared.
  Other devices remain in the status before the error stop occurred.
  To clear the statuses, turn OFF or reset (turn RES signal ON (0.1 s) and then OFF) the inverter.

1.9.2 Data read by controlling read command (from OFF to ON)

The operation mode and set frequency of the inverter can be read.

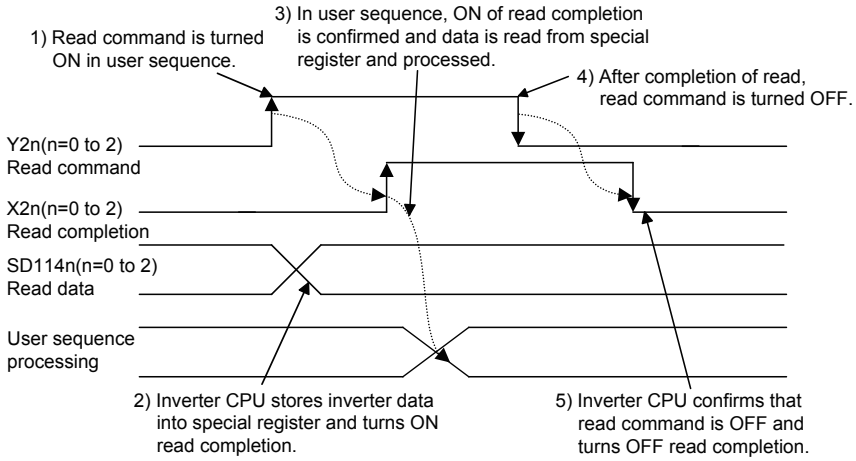
Device number	Name	Read instruction	Read completion	Data access condition
SD1140	Operation mode setting read	Y20	X20	Always accessible
SD1141	Set frequency read (RAM)	Y21	X21	
SD1142	Set frequency read (EEPROM)	Y22	X22	

For the data devices above, data is stored when the read command switches from OFF to ON and read completion switches from OFF to ON.

Data is not refreshed while the read command is ON. (Data is not updated.)

Data is refreshed by turning the read command OFF and ON again.

Time chart of each data read


1) Read command is turned ON in user sequence.
3) In user sequence, ON of read completion is confirmed and data is read from special register and processed.
4) After completion of read, read command is turned OFF.
Y2n(n=0 to 2) Read command
X2n(n=0 to 2) Read completion
SD114n(n=0 to 2) Read data
User sequence processing
2) Inverter CPU stores inverter data into special register and turns ON read completion.
5) Inverter CPU confirms that read command is OFF and turns OFF read completion.

◆Operation mode setting read (SD1140)

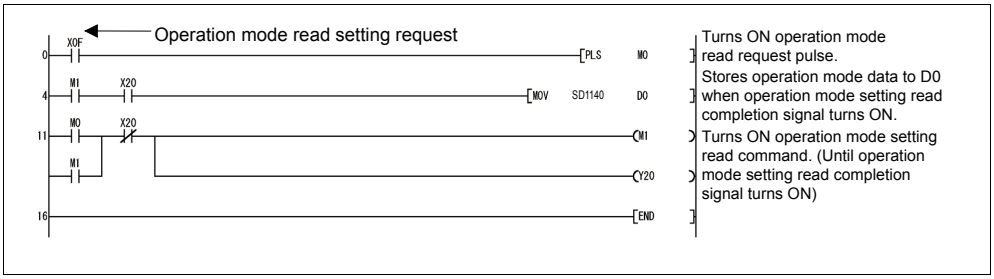
Data content	Operation mode
H0000	NET operation mode
H0001	External operation mode
H0002	PU operation mode

NOTE

- When **Pr.79 Operation mode selection** ≠ "0", the setting is applied. However, if **Pr.79** = "3 or 4", "H0002" (PU operation mode) is applied.

<Program example of reading operation mode settings>

The following description is of a program that reads out the operation mode data to D0.



◆Set frequency read (RAM) (SD1141)

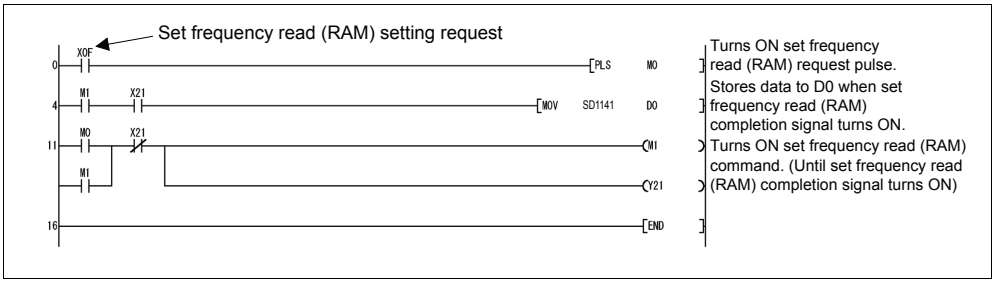
The frequency set in RAM can be read out from SD1141. Its increment is 0.01 Hz.

(For example, "6000" means 60.00 Hz.)

If the rotation rate is set, the increment is 1 r/min or 0.1 r/min. (According to the setting value of **Pr.811**)

<Program example of reading the set frequency (RAM)>

The following description is of a program that reads out the set frequency (RAM) to D0.


Set frequency read (RAM) setting request
XOF
PLS M0
Turns ON set frequency read (RAM) request pulse.
M1
X21
MOV SD1141 D0
Stores data to D0 when set frequency read (RAM) completion signal turns ON.
M0
X21
M1
Turns ON set frequency read (RAM) command. (Until set frequency read (RAM) completion signal turns ON)
Y21
END

NOTE

- The frequency to be read is not the command value of an external signal.

◆Set frequency read (EEPROM) (SD1142)

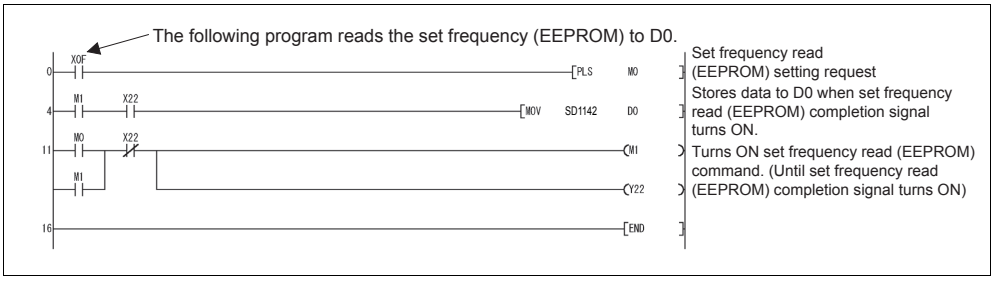
The frequency set in EEPROM can be read from SD1142. Its increment is 0.01 Hz.

(For example, "6000" means 60.00 Hz.)

If the rotation rate is set, the increment is 1 r/min or 0.1 r/min. (According to the setting value of **Pr.811**)

<Program example of reading the set frequency (EEPROM)>

The following description is of a program that reads out the set frequency (EEPROM) to D0.


The following program reads the set frequency (EEPROM) to D0.
XOF
PLS M0
Set frequency read (EEPROM) setting request
M1
X22
MOV SD1142 D0
Stores data to D0 when set frequency read (EEPROM) completion signal turns ON.
M0
X22
M1
Turns ON set frequency read (EEPROM) command. (Until set frequency read (EEPROM) completion signal turns ON)
Y22
END

NOTE

- The frequency to be read is not the command value of an external signal.

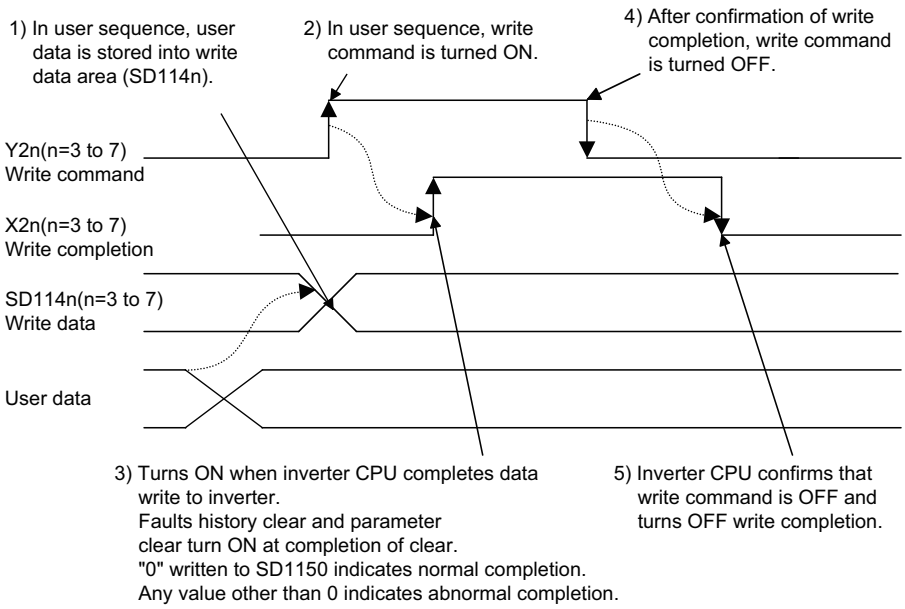
1.9.3 Data writing method by controlling write command (from OFF to ON)

Writing of an operation mode and setting frequency to the inverter, a batch clear of fault records, and all parameter clear can be executed.

Device number	Name	Write instruction	Write completion	Data access condition
SD1143	Writing the operation mode setting	Y23	X23	**Pr.79**=0, 2
SD1144	Writing the setting frequency (RAM)	Y24	X24	PU operation mode or NET operation mode
SD1145	Writing the setting frequency (EEPROM)	Y25	X25	
SD1146	Batch clearing of fault records	Y26	X26	Always accessible
SD1147	All parameter clear	Y27	X27	According to the setting of **Pr.77**

The data above is written at the point when write completion turns ON after the write command turns from OFF to ON.
(Written at clear completion of SD1146 executed for fault record batch clear and SD1147 for all parameter clear.)
To write again, the write command must be turned OFF and then ON again.

Time charts of a data write

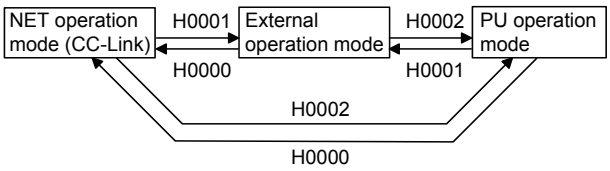

1) In user sequence, user data is stored into write data area (SD114n).
2) In user sequence, write command is turned ON.
4) After confirmation of write completion, write command is turned OFF.
Y2n(n=3 to 7)
Write command
X2n(n=3 to 7)
Write completion
SD114n(n=3 to 7)
Write data
User data
3) Turns ON when inverter CPU completes data write to inverter.
Faults history clear and parameter clear turn ON at completion of clear.
"0" written to SD1150 indicates normal completion.
Any value other than 0 indicates abnormal completion.
5) Inverter CPU confirms that write command is OFF and turns OFF write completion.

◆Writing operation mode settings (SD1143)

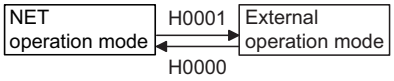
Data content:

Data content	Operation mode
H0000	NET operation mode
H0001	External operation mode
H0002	PU operation mode

The method for changing operation modes is shown in the following chart when **Pr.79 Operation mode selection** = "0".



When **Pr.79** = "2", the chart is as follows.



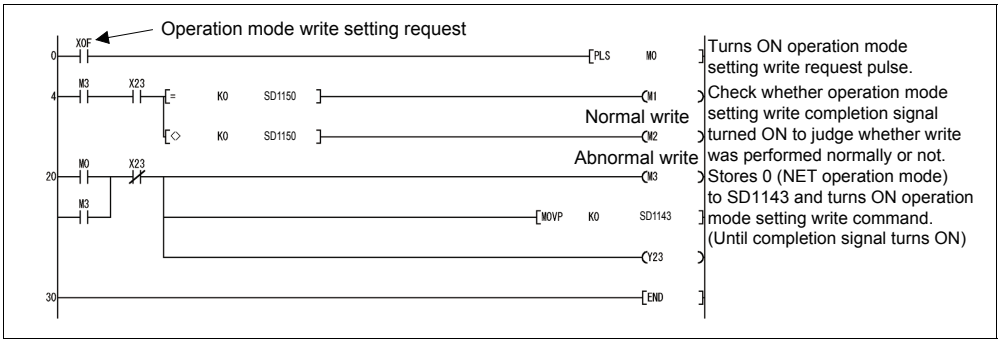
NOTE

- When **Pr.79** ≠ "0", the mode is fixed.

There are no limiting conditions for operation mode transitions.
When the operation mode settings are completed normally, write completion signal (X23) turns ON at the same time as SD1150 is set to "0".
Writing any setting value other than H0000 to H0002 or executing writing while the inverter is operating causes the write completion signal (X23) to turn ON at the same time as setting HFFFF in SD1150, resulting in error completion.
If an error completion occurs, the operation mode is not changed.

<Program example of writing operation mode settings>

The following description is of the program that changes the operation mode to NET operation mode.


Operation mode write setting request
X0F
PLS M0
Turns ON operation mode setting write request pulse.
M3 X23
= K0 SD1150
M1
Check whether operation mode setting write completion signal turned ON to judge whether write was performed normally or not.
Normal write
<> K0 SD1150
M2
Abnormal write
M0 X23
M3
M3
Stores 0 (NET operation mode) to SD1143 and turns ON operation mode setting write command. (Until completion signal turns ON)
MOVP K0 SD1143
Y23
END

◆Setting frequency write (RAM) (SD1144)

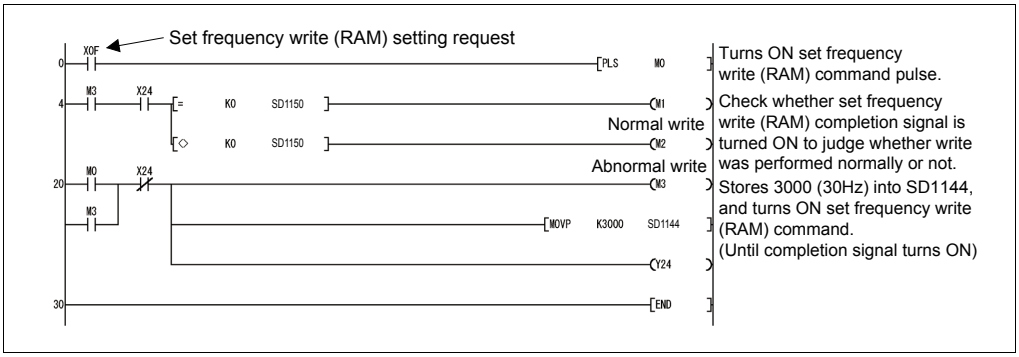
The content of SD1144 is written to the RAM as setting frequency. Its increment is 0.01 Hz.
(For example, 60.00 Hz is written as "6000".)
If the rotation speed is set, the increment is 1 r/min or 0.1 r/min. (According to the setting value of **Pr.811**)
The frequency can be set within the range of 0 to 12000 (0 to 120.00 Hz).
When frequency settings are written normally, the write completion signal (X24) turns ON at the same time as SD1150 is set to "0".
Executing writing with any value that is outside the specified range causes the write completion signal (X24) to turn ON at the same time as setting HFFFF in SD1150, resulting in error completion. If an error completion occurs, the setting frequency is not changed.

POINT

- This can be set in PU operation mode and NET operation mode. Refer to the Instruction Manual of the inverter.

<Program example of writing the setting frequency (RAM)>

The following description is of a program that changes the setting frequency (RAM) to 30 Hz.


Set frequency write (RAM) setting request
X0F
PLS M0
Turns ON set frequency write (RAM) command pulse.
M3 X24
= K0 SD1150
M1
Check whether set frequency write (RAM) completion signal is turned ON to judge whether write was performed normally or not.
Normal write
◇ K0 SD1150
M2
Abnormal write
M0 X24
M3
Stores 3000 (30Hz) into SD1144, and turns ON set frequency write (RAM) command. (Until completion signal turns ON)
MOVP K3000 SD1144
Y24
END

◆Setting frequency write (EEPROM) (SD1145)

The content of SD1145 is written to EEPROM as setting frequency. Its increment is 0.01 Hz.

(For example, 60.00 Hz is written as "6000".)

If the rotation rate is set, the increment is 1 r/min or 0.1 r/min. (According to the setting value of **Pr.811**)

The frequency can be set within the range of 0 to 12000 (0 to 120.00 Hz).

When frequency settings are written normally, the write completion signal (X25) turns ON at the same time as SD1150 is set to "0".

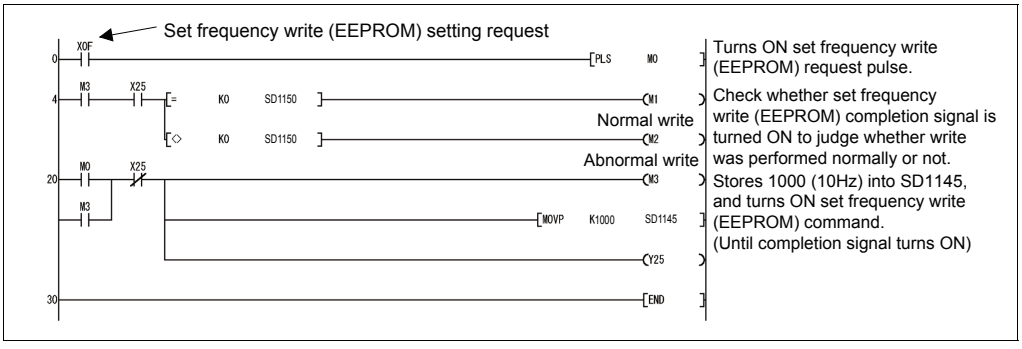
Executing writing with any value that is outside the specified range causes the write completion signal (X25) to turn ON at the same time as setting HFFFF in SD1150, resulting in error completion. If an error completion occurs, the setting frequency is not changed.

POINT

- This can be set in PU operation mode and NET operation mode. Refer to the Instruction Manual of the inverter.

<Program example of writing setting frequency (EEPROM)>

The following description is of a program that changes the setting frequency (EEPROM) to 10 Hz.


Set frequency write (EEPROM) setting request
X0F
PLS M0
Turns ON set frequency write (EEPROM) request pulse.
M3 X25
= K0 SD1150
M1
Check whether set frequency write (EEPROM) completion signal is turned ON to judge whether write was performed normally or not.
Normal write
◇ K0 SD1150
M2
Abnormal write
M0 X25
M3
Stores 1000 (10Hz) into SD1145, and turns ON set frequency write (EEPROM) command. (Until completion signal turns ON)
MOVP K1000 SD1145
Y25
END

NOTE

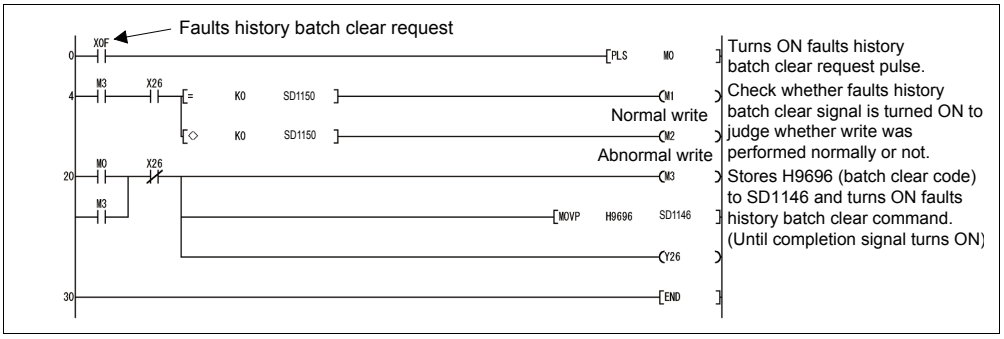
- When set frequencies need to be changed often, use the device SD1144 "set frequency (RAM)". There is a limitation on the number of times EEPROM can be written to. (Approximately 100,000 times)

◆Batch clear of fault records (SD1146)

When H9696 is written to SD1146, fault records are cleared in a batch.
When clearing is completed, the write completion signal (X26) turns ON at the same time as SD1150 is set to "0".
Executing writing with any value that is outside the specified range or writing while the inverter is running causes the write completion signal (X26) to turn ON at the same time as setting HFFFF in SD1150, resulting in error completion. In the case of error completion, the fault records are not cleared.

<Program example of batch clearing of fault records>

The following description is of the program that batch clears fault records.



◆Parameter clear (SD1147)

When H9696 or H9966 is written to SD1147, all parameters are cleared. When H5A5A or H55AA is written to SD1147, parameters except the communication parameters are cleared. (Refer to the Instruction Manual of the inverter.)

Device No.	Setting value	Communication parameters	Other parameters	Details
SD1147	H9696	○	○	Terminal functions are not cleared.
	H9966	○	○	Terminal functions are cleared.
	H5A5A	×	○	Terminal functions are not cleared.
	H55AA	×	○	Terminal functions are cleared.

○: Clear, ×: Not clear

When clearing is complete, the write completion signal (X27) turns ON at the same time as SD1150 is set to "0".
Executing writing with any value that is outside the specified range or writing while the inverter is running causes the write completion signal (X27) to turn ON at the same time as setting HFFFF in SD1150, resulting in error completion. In the case of an error completion, the parameters are not cleared.

NOTE

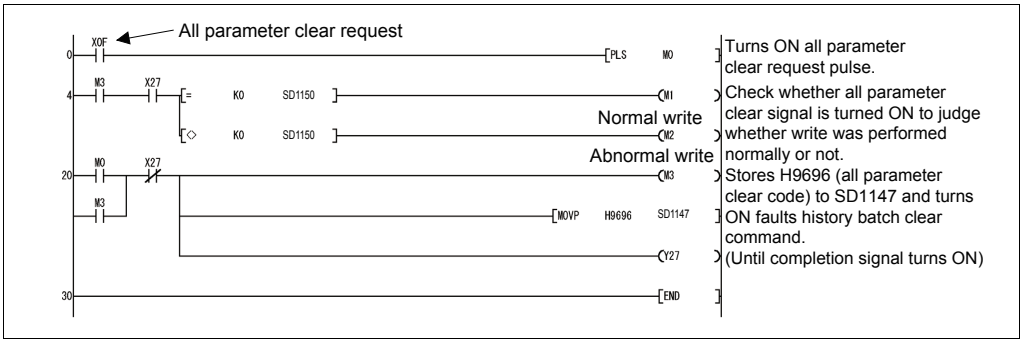
- Identify the terminal function parameters and communication parameters in the parameter list. (Refer to the Instruction Manual of the inverter.)

POINT

- This can be set in the PU operation mode and NET operation mode. Refer to the Instruction Manual of the inverter.

<Program example of clearing all parameters>

The following description is of the program that clears all parameters.


All parameter clear request
X0F
PLS M0
Turns ON all parameter clear request pulse.
M3 X27 = K0 SD1150 M1
Check whether all parameter clear signal is turned ON to judge whether write was performed normally or not.
Normal write
M2
Abnormal write
M3
M0 X27
M3
MOVP H9696 SD1147
Stores H9696 (all parameter clear code) to SD1147 and turns ON faults history batch clear command.
Y27
(Until completion signal turns ON)
END

NOTE

- When parameter clear/all clear is executed, communication parameters are also cleared. Thus communication with FR Configurator2 (Developer) becomes impossible.

♦Related device♦

Device SD1150: inverter parameter access error (refer to page 42)

1.9.4 Inverter operating status control

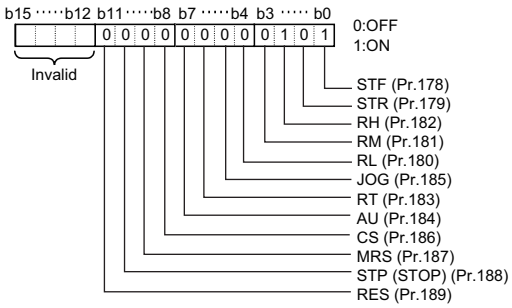
Device number	Name	Data access condition
SD1148	Inverter operating status control	Always accessible. However, this is only active in External/NET operation mode. (Disabled in PU operation mode)
SD1149	Inverter operating status control enable/disable	

◆Inverter operating status control (SD1148)

SD1148 is a device for controlling the operating status of the inverter. The inverter operation can be controlled by turning the bits b0 to b11 of SD1148 ON/OFF (1,0).

All initial values are "0".

Example) When SD1148 is set to "5", the bits b0 and b2 are turned to 1(ON) and thus STF and RH are turned ON, creating the fast forward rotation command.



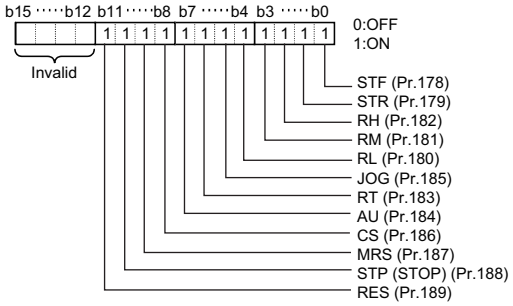
NOTE

- The functions of SD1148 bits are assigned by **Pr.178 to Pr.189** in the same way as for the external input terminal. Note that SQ signal (setting value: 50) cannot be assigned.
- Turn ON SM1255 (special register selection) before using SD1148. (Refer to page 20.)

◆Inverter operating status control enable/disable setting (SD1149)

The inverter operating status control by SD1148 and SM1200 to SM1211 can be enabled/disabled. Control of the bits of SD1148 and SM1200 to SM1211 are enabled by turning the corresponding bits b0 to b11 of SD1149 ON/OFF (1, 0). All initial values are "0".

Example) When SD1149 is set to H1F, the bits b0 to b11 change to 1 (ON) disabling all inputs through external terminals, thus enabling operation control by the inverter operation control (SD1148) and inverter operating status control flag (SM1200 to SM1211).

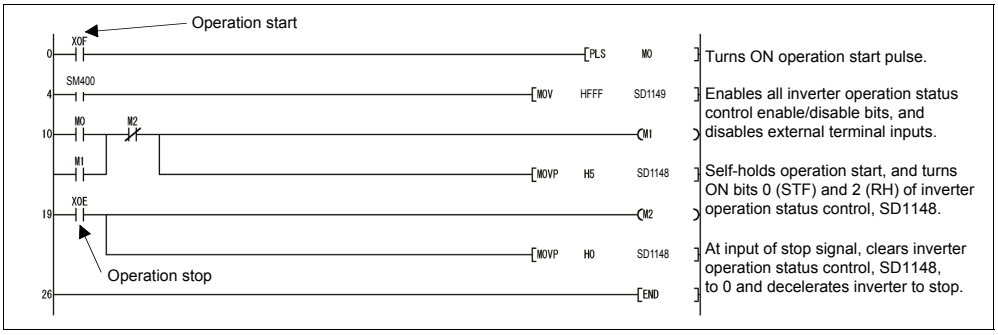


NOTE

- When SD1148 and SM1200 to SM1211 are enabled by SD1149, control by external terminal input or CC-Link remote input are disabled for the bits that are enabled. (Same as setting **Pr.178 to Pr.189** to "no function".)
- When terminals are enabled by PLC function, the control through external terminals is disabled.
- Input through external terminals is always enabled for SQ signal.
  (Control of SQ signal cannot be performed from each SD1149 bit.)

<Program example of operation command settings>

Program example of operating the inverter in fast forward rotation.


Operation start
X0F
PLS M0
Turns ON operation start pulse.
SM400
MOV H FFF SD1149
Enables all inverter operation status control enable/disable bits, and disables external terminal inputs.
M0
M2
M1
MOVP H5 SD1148
Self-holds operation start, and turns ON bits 0 (STF) and 2 (RH) of inverter operation status control, SD1148.
X0E
M2
MOVP H0 SD1148
At input of stop signal, clears inverter operation status control, SD1148, to 0 and decelerates inverter to stop.
Operation stop
END

1.9.5 Inverter parameter access error (SD1150)

Device number	Name	Data access condition
SD1150	Inverter parameter access error	Always accessible

When an out-of-range setting value is written to a parameter or an out-of-range frequency is set using sequence programs, or when writing is attempted while writing is disabled, a write error occurs and an error code is stored in SD1150.

<Parameters>

Parameter number + H8000 is stored to SD1150.

Example) If an error occurs when **Pr.0 Torque boost** is written, H8000 (H0 + H8000) is stored to SD1150.

If an error occurs when **Pr.10 DC injection brake operation frequency** is written, H800A is stored to SD1150.

<Operation mode, setting frequency, batch clear of fault records, and all parameter clear>

HFFFF is stored to SD1150. (The initial values is "0".)

POINT

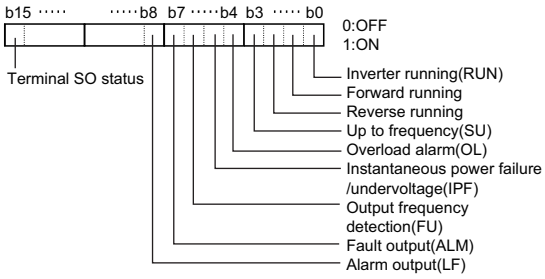
- The error code stored after the error occurrence will be cleared by writing "0" in SD1150. (The error code is retained until "0" is written in SD1150.)

1.9.6 Inverter status (SD1151)

Device number	Name	Data access condition
SD1151	Inverter status	Always accessible

Operating status of the inverter is stored.

Each bit is set according to the status of the inverter.



1.9.7 User-defined error (SD1214)

By setting the values "16 to 20" in SD1214, alarms for the inverter can be created. When an alarm occurs, the inverter stops. Values other than "16 to 20" are invalid. Furthermore, this function is disabled when **Pr.414** = "0".
The created alarms are recognized as E.16 to E.20 by the inverter.

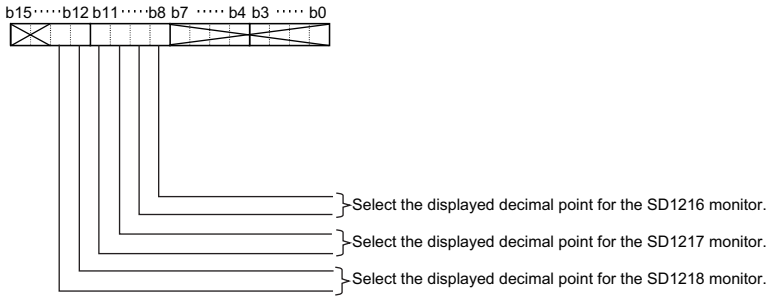
1.9.8 Monitor setting selection (SD1215 to SD1218)

Monitor names and units need to be set in SD1216, SD1217, and SD1218 by using G.PRR, GP.PRR, UMSG instruction (refer to page 193).
To display the monitor names and units set in SD1216 to SD1218 on the parameter unit (FR-PU07), set "40 to 42" in **Pr.774 to Pr.776**. (For details of **Pr.774 to Pr.776**, refer to **the Instruction Manual (Detailed)** of the inverter.)

Device	Monitor description	Pr.774 to Pr.776 setting
SD1216	User monitor 1	40
SD1217	User monitor 2	41
SD1218	User monitor 3	42

To display the monitors set in SD1216 to SD1218 to decimal places, set SD1215 as follows.

<Setting of SD1215>


b15 ····· b12 b11 ····· b8 b7 ····· b4 b3 ····· b0
Select the displayed decimal point for the SD1216 monitor.
Select the displayed decimal point for the SD1217 monitor.
Select the displayed decimal point for the SD1218 monitor.

*1 Ignore bits other than those above.

<Decimal point display setting>

bn + 1	bn	Increment
0	0	1 increment (no decimals)
0	1	0.1 increment
1	0	0.01 increment
1	1	0.001 increment

Setting example:

1. To display SD1216 without decimals
   - Set H0000 in SD1215.
   - Set "40" in **Pr.774**.
2. To display SD1216 in 0.1 increment, and SD1218 in 0.001 increment.
   - Set H3100 in SD1215.
   - Set "40" in **Pr.774** and "42" in **Pr.775**.

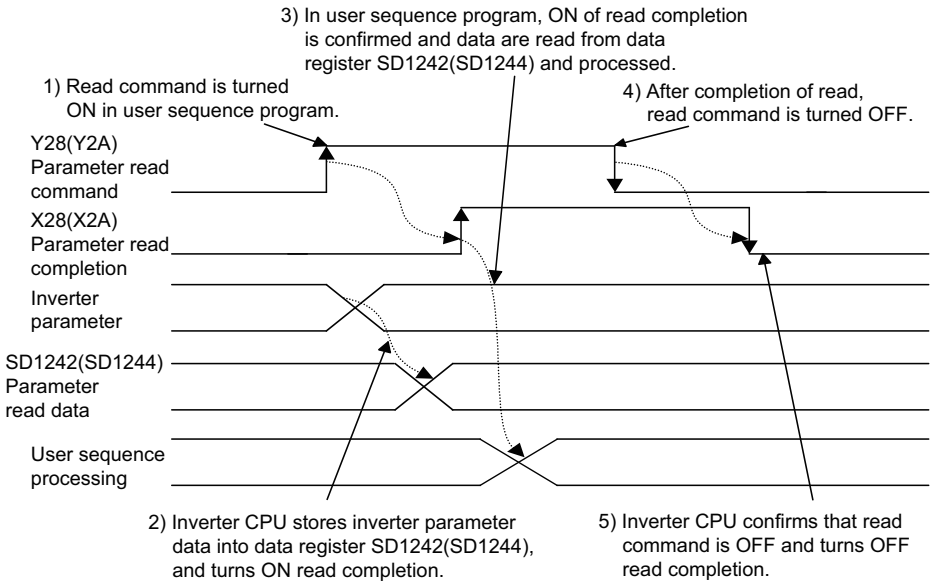
1.10 Read/Write method of inverter parameters

1.10.1 Reading inverter parameters

Device number	Name	Command	Completion	Data access condition (Operation mode)
SD1241	Parameter number (RAM)	Y28	X28	Always allowed
SD1242	Parameter content (RAM)			
SD1234	Second parameter change (RAM)			
SD1243	Parameter number (EEPROM)	Y2A	X2A	
SD1244	Parameter content (EEPROM)			
SD1235	Second parameter change (EEPROM)			

To read a parameter, store the parameter number in SD1241 (SD1243) and turn ON Y28 (Y2A). The parameter content will be stored in SD1242 (SD1244). After the reading is complete, X28 (X2A) turns ON to notify of the completion. (Use the device numbers in parentheses to read a parameter setting value from EEPROM.)
When reading a calibration parameter **(Pr.902 to Pr.935)**, set a value listed below in SD1234 (SD1235) to read each calibration value.
0: Setting value (frequency)
1: Analog value by parameter setting
2: Analog value input from terminal
If an access error such as non-existent parameter occurs, the value of the specified parameter number plus 8000H is stored in SD1150. (Refer to **page 42**.)

Inverter parameter data read timing chart


3) In user sequence program, ON of read completion is confirmed and data are read from data register SD1242(SD1244) and processed.
1) Read command is turned ON in user sequence program.
4) After completion of read, read command is turned OFF.
Y28(Y2A) Parameter read command
X28(X2A) Parameter read completion
Inverter parameter
SD1242(SD1244) Parameter read data
User sequence processing
2) Inverter CPU stores inverter parameter data into data register SD1242(SD1244), and turns ON read completion.
5) Inverter CPU confirms that read command is OFF and turns OFF read completion.

1.10.2 Writing inverter parameters

Device number	Name	Command	Completion	Data access condition (Operation mode)
SD1241	Parameter number (RAM)	Y29	X29	PU or NET operation mode (depending on **Pr.77**)
SD1242	Parameter content (RAM)			
SD1234	Second parameter change (RAM)			
SD1243	Parameter number (EEPROM)	Y2B	X2B	
SD1244	Parameter content (EEPROM)			
SD1235	Second parameter change (EEPROM)			

To write to a parameter, store the parameter number in SD1241 (SD1243) and the value to be written in SD1242 (SD1244), and turn ON Y29 (Y2B) to execute writing. After the writing completes, X29 (X2B) turns ON to notify of the completion. (Use the device numbers in parentheses to write a parameter setting value to EEPROM.)
When writing to a calibration parameter **(Pr.902 to Pr.935)**, set a value listed below in SD1234 (SD1235) to write each calibration value.

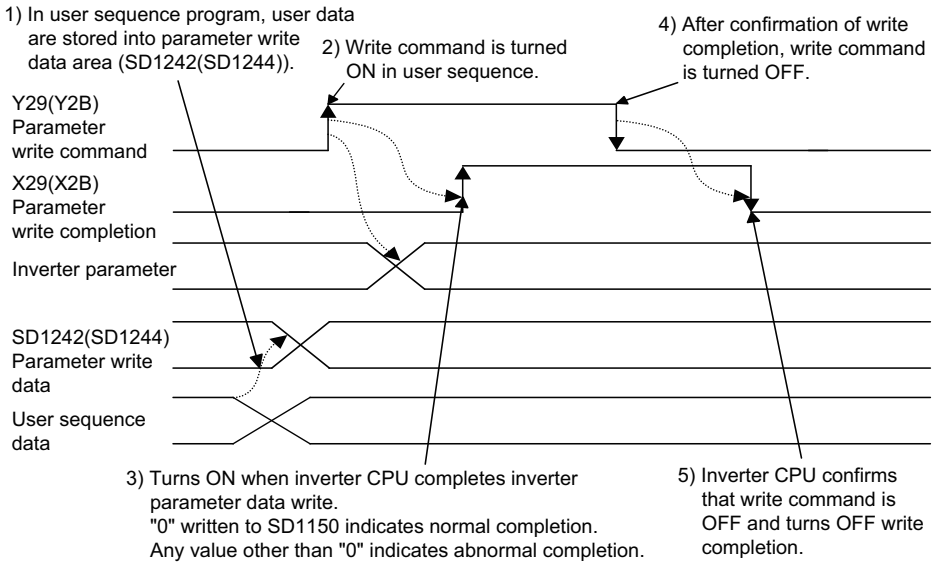
0: Setting value (frequency)
1: Analog value by parameter setting
2: Analog value input from terminal

When the inverter parameter write completion signal (X29 (RAM) or X2B (EEPROM)) turns ON with normal completion, SD1150 is set to 0.
If an error in access to a parameter such as setting an out-of-range value and writing during inverter operation occurs, the write completion signal (X29 (RAM) or X2B (EEPROM)) turns ON and the value of the parameter number plus H8000 is set in SD1150 as soon as the write completion signal (X29 (RAM) or X2B (EEPROM)) is turned ON, resulting in error completion. When an error completion occurs, the parameter is not written. (For example, if an error occurs in **Pr.0 Torque boost**, H8000 is written to SD1150.)
For details on whether inverter parameter writing is allowed, refer to **Pr.77 Parameter write selection**.

POINT

- Inverter parameter writing must be performed in PU operation mode or NET operation mode. (Refer to the Instruction Manual of the inverter.)

Inverter parameter data write timing chart

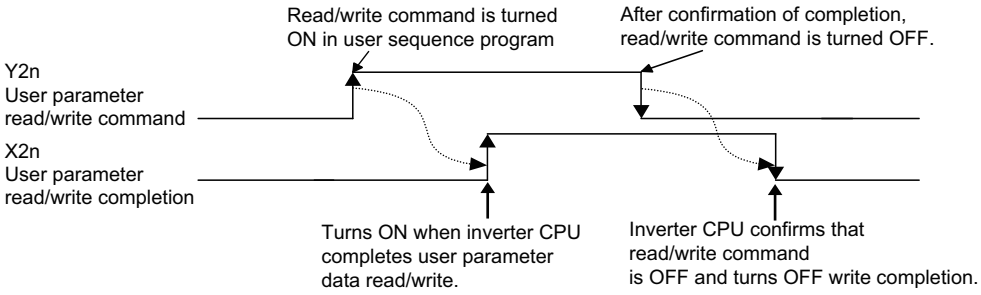

1) In user sequence program, user data are stored into parameter write data area (SD1242(SD1244)).
2) Write command is turned ON in user sequence.
4) After confirmation of write completion, write command is turned OFF.
Y29(Y2B) Parameter write command
X29(X2B) Parameter write completion
Inverter parameter
SD1242(SD1244) Parameter write data
User sequence data
3) Turns ON when inverter CPU completes inverter parameter data write.
"0" written to SD1150 indicates normal completion.
Any value other than "0" indicates abnormal completion.
5) Inverter CPU confirms that write command is OFF and turns OFF write completion.

1.11 User area reading/writing

Inverter parameters **Pr.1150 to Pr.1199** can be used as user parameters.
Since this parameter area and the devices D206 to D255 used in PLC function are accessible to each other, values set in **Pr.1150 to Pr.1199** are available in sequence programs. In addition, operation results in sequence programs can be monitored with **Pr.1150 to Pr.1199**.

Device number	Parameter number	Name	Command	Completion	Data access
D206 to D255	Pr.1150 to Pr.1199	User parameter read (RAM)	Y2C	X2C	Always allowed
		User parameter write (RAM)	Y2D	X2D	
		User parameter read (EEPROM/RAM)	Y2E	X2E	
		User parameter write (EEPROM/RAM)	Y2F	X2F	

Turn the read/write instruction from OFF to ON and then turn the read/write completion ON to read/write the user parameters from RAM and EEPROM.


Read/write command is turned ON in user sequence program
After confirmation of completion, read/write command is turned OFF.
Y2n
User parameter read/write command
X2n
User parameter read/write completion
Turns ON when inverter CPU completes user parameter data read/write.
Inverter CPU confirms that read/write command is OFF and turns OFF write completion.

POINT

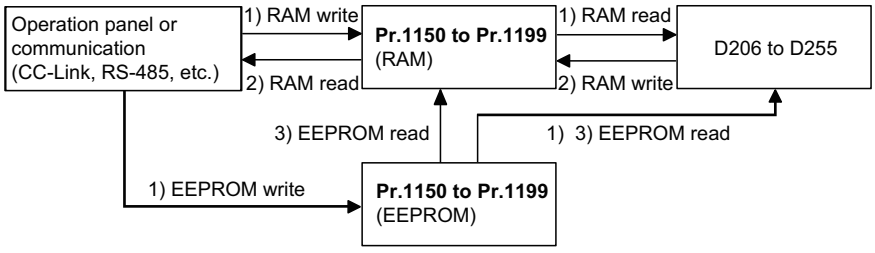
- Application example of user parameter
  Operation timings can be adjusted by assigning a timer in D206 and varying the value set in the timer. Values can be set to the timer with the **Pr.1150** setting without changing the program.

The user parameters **(Pr.1150 to Pr.1199)** and the devices (D206 to D255) can be freely read and written. Data transfer between **Pr.1150 to Pr.1199** and D206 to D255 is automatically executed.

1) Writing of user parameter and devices
When values are written to **Pr.1150 to Pr.1199** via the operation panel, a parameter unit, or communication, they are written to the RAM area and the EEPROM area for parameter storage and also to D206 to D255 at the same time.

2) Reading user parameters and devices
When values are written to D206 to D255 using the PLC function, they are written to the RAM area for storing parameters **(Pr.1150 to Pr.1199)** and read via the operation panel, a parameter unit, or communication. (Since they are not written to EEPROM, resetting the power restores the previous values.)

3) Process at inverter reset or power restoration
When the inverter is reset, the values of **Pr.1150 to Pr.1199** stored in EEPROM are transferred to the RAM area and to D206 to D255.



NOTE

- If EEPROM is read after writing a parameter directly (to RAM), the values in RAM are replaced by the values in EEPROM.
- When **Pr.342 Communication EEPROM write selection** = "1", RAM values are read or written.

1.12 Analog I/O function

1.12.1 Analog input

Analog input values from terminals 1, 2, and 4 can be read from SD1245 to SD1247.

Device number	Terminal name	Setting increments	Data access condition
SD1245	Terminal 1 input	0.1%	Always allowed
SD1246	Terminal 2 input	0.1%	
SD1247	Terminal 4 input	0.1%	

The actual reading is performed at END processing of the sequence program.

NOTE

- The full scale value of analog input depends on the setting values of **Pr.73 Analog input selection** and **Pr.267 Terminal 4 input selection**. Refer to the Instruction Manual of the inverter.

1.12.2 Analog output

Write values from SD1251 to SD1254 to enable analog output from respective terminals.
Write "70" to the output signal selection parameter of each terminal (Terminal FM/CA: **Pr.54**, Terminal AM: **Pr.158**, FR-A8AY Terminal AM0, AM1: **Pr.306**, **Pr.310**) to enable output from PLC function.

Device number	Terminal name	Setting increments	Data access condition
SD1251	Terminal FM/CA	0.1%	Always allowed
SD1252	Terminal AM	0.1%	
SD1253	Terminal AM0 (FR-A8AY)	0.1%	
SD1254	Terminal AM1 (FR-A8AY)	0.1%	

The actual reading is performed at END processing of the sequence program.

1.13 Pulse train input function

Pulse train input values from terminal JOG can be read with the PLC function.

To read pulse train input values with the PLC function, set the terminal JOG by setting **Pr.291 Pulse train I/O selection** = "1, 11, 21, or 100" and **Pr.384 Input pulse division scaling factor** = "0 (initial value)".

After setting terminal JOG, set SD1240 to "1" to start counting the number of sampling pulses and accumulated count values.

Pulse train (the number of sampling pulses) from terminal JOG is stored to SD1236.

When the sampling pulses overflow, make adjustment with the setting of **Pr. 416** and **Pr. 417**.

The number of sampling pulses

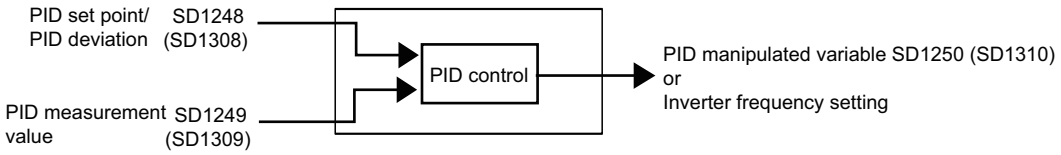
= the number of input pulses per count cycle × pre-scale setting value (**Pr. 417**) × increments scaling factor (**Pr. 416**)

Parameter	Name	Initial value	Setting range	Description
291	Pulse train I/O selection	0	0, 10, 20	Terminal JOG
			1, 11, 21, 100	Pulse train input
416	Pre-scale function selection	0	0 to 5	Pre-scale function selection (increments scaling factor) 0: No function 1: ×1 2: ×0.1 3: ×0.01 4: ×0.001 5: ×0.0001
417	Pre-scale setting value	1	0 to 32767	Set the pre-scale value to calculate the number of sampling pulse when inputting the pulse train.

Device number	Name	Setting range	Description
SD1236	Pulse train input sampling pulse	0 to 32767	The number of pulses counted in count cycle is stored.
SD1237	Pulse train input cumulative count value L	0 to 99999999	The cumulative value of the number of sampling pulses is stored.
SD1238	Pulse train input cumulative count value H		
SD1239	Reset request of pulse train input count	0	Not clear
		1	Count clear
SD1240	Count start of the pulse train input	0	Stop counting
		1	Start counting

1.14 PID control

Set **Pr.128 (Pr.753)** to enable setting of set point/ deviation and measured value for PID control with PLC function.
PID operation is performed using the value of SD1248 (SD1308) as the set point/deviation, and the value of SD1249 (SD1309) as the measured value. The manipulated amount will be stored in SD1250 (SD1310).
To perform PID control using the PLC function, set "1" in SD1255 instead of X14 signal.
When **Pr.128** = "70, 71, 80, or 81", PID operation is performed after the start. Thus, even if "1" is set in SD1255, the manipulated amount of SD1250 remains the same and the value of SD1250 is unchanged from "0".
When **Pr.128** = "90, 91, 100, or 101" and "1" is set in SD1255, PID operation is performed and the operation result is applied to the manipulated amount SD1250.
Set **Pr.753** to enable the second PID control (SD1308 to SD1310).



Parameter	Name	Initial value	Setting range	Description	
128 753	PID action selection	0	0	PID control disabled	
			10, 11, 20, 21, 40 to 43, 50, 51, 60, 61, 1000, 1001, 1010, 1011, 2000, 2001, 2010, 2011	For details, refer to the Instruction Manual of the inverter.	
			70	PID reverse action	Deviation signal input (PLC function)
			71	PID forward action	
			80	PID reverse action	Measured value and set point input (PLC function)
			81	PID forward action	
			90	PID reverse action	Deviation signal input (PLC function) Not applied to inverter output frequency.
			91	PID forward action	
			100	PID reverse action	Measured value and set point input (PLC function) Not applied to inverter output frequency.
			101	PID forward action	

Device number	Name	Setting range	Description
SD1248	PID control set point/ deviation	Set point: 0 to 100% *1 Deviation: -100 to 100%	Set the PID set point or the PID deviation (in 0.01% increments*1).
SD1249	PID control measured value	0 to 100% *1	Set the PID measured value (in 0.01% increments*1).
SD1250	PID control manipulated amount	-100 to 100%	Stores the PID manipulated amount (in 0.01% increments).
SD1255	PID operation control	0	Stops PID control.
		1	Starts PID control.
SD1308	Second PID control set point/deviation	Set point: 0 to 100% *1 Deviation: -100 to 100%	Set the second PID set point or the second PID deviation (in 0.01% increments*1).
SD1309	Second PID control measured value	0 to 100% *1	Set the second PID measured value (in 0.01% increments*1).
SD1310	Second PID control manipulated amount	-100 to 100%	Stores the second PID manipulated amount (in 0.01% increments).

*1 When both **Pr.934** and **Pr.935** are set to values other than "9999", the set point of SD1248 (SD1308) and the measured value of SD1249 (SD1309) are set as coefficients. The setting range is from the smaller coefficient to the larger one set in **Pr.934** and **Pr.935**.
(For details of **Pr.934** and **Pr.935**, refer to the Instruction Manual of the inverter.)

NOTE

- Depending on the setting value of **Pr.128 (Pr.753)**, SD1248 (SD1308) automatically switches between set point and deviation.
- When **Pr.128 (Pr.753)** is set to deviation input "70, 71, 90, or 91", the value set as the measured value in (SD1249 (SD1309)) becomes invalid.
- If an out-of-range value is set, the maximum value (or the minimum value) of the setting range is used for operation.

1.15 Clearing the flash memory of the PLC function

Set **Pr.498** to "9696" to clear the flash memory used for the PLC function.

Parameter	Name	Initial value	Setting range	Description	
498	PLC function flash memory clear	0	0, 9696 (0 to 9999)	0: Clears the flash memory fault display (no operation after writing while the flash memory is in normal operation).	Write
				9696: Clears the flash memory (no operation after writing during flash memory fault).	
				Other than 0 and 9696: Outside of the setting range	
				0: Normal display	Read
				1: The flash memory has not been cleared because the PLC function is enabled.	
				9696: During flash memory clearing operation or flash memory fault	

- If the file password (registered by FR Configurator2 (Developer)) of the PLC function has been forgotten, use **Pr.498** to clear the flash memory and unlock the file password.
- The flash memory can only be cleared when the PLC function is disabled (**Pr.414** ="0").
- Setting **Pr.498** = "9696" clears the flash memory. It takes approximately 30 s at the maximum to clear the flash memory.
- When the flash memory clearing is completed, the **Pr.498** value changes to "0" to notify the completion.
- Check if **Pr.498** = "0" before turning OFF the inverter power or performing an inverter reset after the flash memory is cleared.
- When the inverter power is turned OFF or an inverter reset is performed during the flash memory clearing operation, the flash memory is not cleared properly. The read value of **Pr.498** becomes "9696" when the flash memory clearing has not been completed properly due to turning OFF of the power or the inverter reset. If the read value of **Pr.498** becomes "9696", clear the flash memory according to the following procedure.
  - FR-DU08
    Set **Pr.498** = "0". Then, set **Pr.498** = "9696" again to retry clearing.
  - FR-LU08 or FR-PU07
    Set **Pr.498** = "9696" again to retry clearing.

NOTE

- Executing this function clears the PLC function program and all parameters of the PLC function. Create the program and set the parameters of the PLC function again.
- While the PLC function is enabled (**Pr.414** = "1 or 2"), setting **Pr.498** = "9696" does not clear the flash memory. When the flash memory clearing is attempted while the PLC function is enabled, the **Pr.498** value changes to "1" to notify that the PLC function is enabled. Disable the PLC function (**Pr.414** = "0"). After the inverter is reset, retry clearing.
- If a value other than "0 or 9696" is set in **Pr.498**, Er1 (write disable error) will occur.

1.16 Constant scan

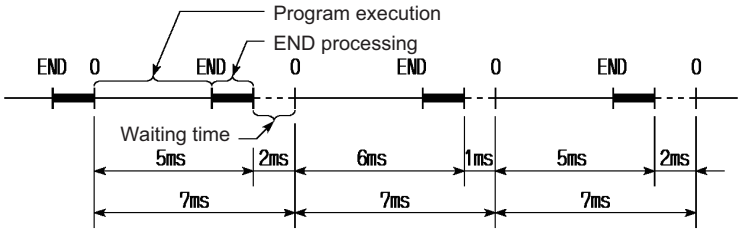
A constant scan time can be maintained for the sequence programs.
Configure the setting using FR Configurator2 (Developer).

PLC parameter	Name	Initial value	Setting range
PLC RAS setting	Constant scan setting	None	0.5 ms to 2000 ms

- A waiting time is automatically set so that the sum of the execution time of the sequence programs and the waiting time is equal to the set constant scan time.
- PLC parameter: Although the setting range of PLC RAS setting is 0.5 ms to 2000 ms, the actual set constant scan time is a minimum of 10 ms. (Increments: 10 ms)

Setting value	Set constant scan time
0.5 ms to 10.0 ms	10 ms
10.5 ms to 20.0 ms	20 ms
...	...
1990.5 ms to 2000.0 ms	2000 ms

- I/O timing
  After END processing is completed, a waiting time is automatically set as shown below.



Constant scan: operation when set to 7 ms.

NOTE

- Processes other than the PLC function are executed even during the waiting time.
- The set constant scan time must meet the following condition:
  Set watchdog timer time > set constant scan time > maximum scan time of program.
- If a scan time is longer than the set constant scan time, "PRG.TIME OVER Error code: 5010" occurs. In this case, the constant scan setting is ignored in the operation.
- If a scan time is longer than the set watchdog timer time, a watchdog timer error is detected and execution of the sequence program stops. (Refer to page 33.)
- Only the "Execute it while waiting for constant scan setting" is enabled for the service processing setting.
  Settings other than "Execute it while waiting for constant scan setting" are ignored and no error occurs even if they are set.
- Scan time monitoring in FR Configurator2 (Developer) monitors the actual scan time excluding the waiting time for constant scan.

MEMO

2 CC-Link communication

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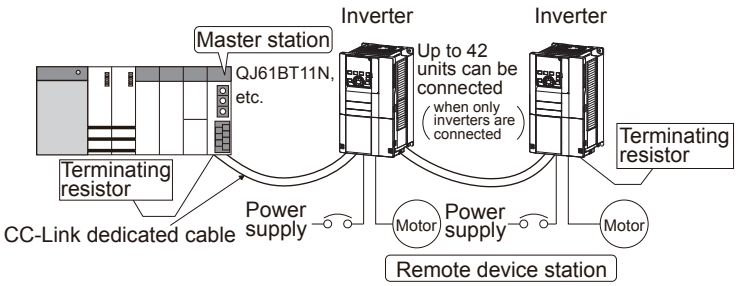
2.4 Buffer memory 64

2.1 System configuration

2.1.1 System configuration example

- Programmable controller side
  Mount the "CC-Link system master/local module" on the main base unit or extension base unit that uses the programmable controller CPU as the master station.
- Use the CC-Link dedicated cable to connect the CC-Link programmable controller module (master station) to the inverter.



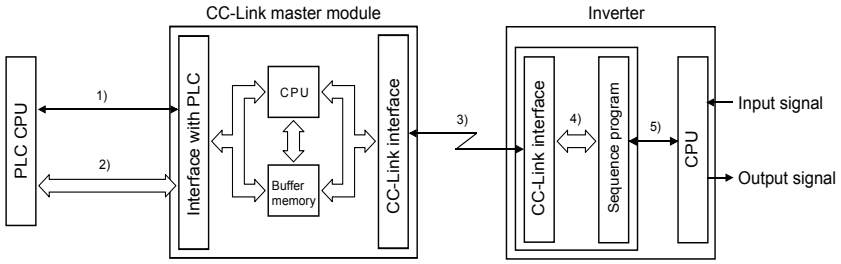
NOTE

- For details on CC-Link communication wiring and the CC-Link cable, refer to the Instruction Manual of the FR-A8NC.

2.1.2 Function block diagram

The following function blocks explain the I/O information flow to and from the inverter in CC-Link.

- Link refresh between the master station of CC-Link system and the inverter is continuously performed at 3.5 to 18 ms (512 points).
- I/O refresh and the sequence program of the master station are executed asynchronously.
- Data read from the inverter is read from the buffer memory of the CC-Link system master/local module using FROM instruction.
- Data to be written to the inverter is written to the buffer memory of the CC-Link system master/local module using TO instruction.



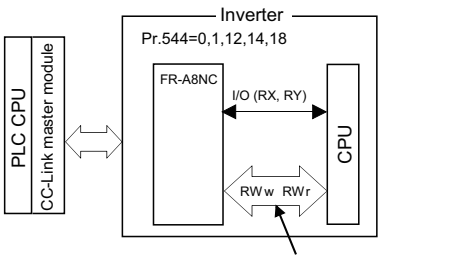
1)	CC-Link module I/O signals	I/O signals assigned to the CC-Link system master/local module. These signals are for communication between the programmable controller CPU and the CC-Link system master/local module.
2)	Reading from/writing to the buffer memory	Information that is input to the inverter can be read, and output information can be written. FROM/TO instruction of the sequence program enables reading from/writing to the buffer memory. For details on the buffer memory, refer to page 64.
3)	CC-Link dedicated cable	The PLC link start instruction is sent from the sequence program. After PLC link starts, link refresh is continuously performed asynchronously with execution of the sequence program.
4)	Sequence program	The sequence program exchanges I/O information between the CC-Link system master/local module and the inverter CPU.
5)	I/O information	The CC-Link system master/local module and the inverter CPU exchange I/O information. (When CC-Link is not used, only 5) is performed and 1) to 4) are not related to the operation.)

NOTE

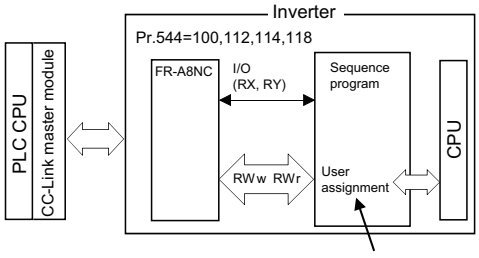
- Programs cannot be read or written via CC-Link communication.

POINT

- The differences between the normal CC-Link communication (**Pr.544** = "1, 2, 12, 14, or 18") and the CC-Link communication with the PLC function (**Pr.544** = "100, 112, 114, or 118") are shown below.



Parameter read/write, monitor, operation commands, etc. have been assigned in advance.



The user must assign parameters, monitors, etc. using sequence programs. Other data read/write, etc. can be assigned freely as user areas.
*Operation and speed commands have been assigned in advance.

2.2 CC-Link parameter

2.2.1 CC-Link extended setting (Pr.544)

The functions of the remote register can be extended.

Parameter number	Name	Initial value	Setting range	CC-Link version	Description
544	CC-Link extended setting	0	0	1	1 station occupied (FR-A5NC compatible) *1
			1		1 station occupied
			12 *2	2	1 station occupied, double
			14 *2		1 station occupied, quadruple
			18 *2		1 station occupied, octuple
			100	1	1 station occupied (PLC function)
			112 *2	2	1 station occupied, double (PLC function)
			114 *2		1 station occupied, quadruple (PLC function)
			118 *2		1 station occupied, octuple (PLC function)

*1 The program used for the conventional series inverter option (FR-A5NC) can be used.

*2 When using the double, quadruple, or octuple settings of the CC-Link Ver.2, station data of the master station must be set to double, quadruple, or octuple. (If the master station is CC-Link Ver.1, this setting is not available.)

NOTE

- The setting becomes valid after inverter reset.

2.3 CC-Link I/O specifications

2.3.1 I/O signals when one station in the CC-Link Ver.1 is occupied (Pr.544 = "100")

The number of device points available in CC-Link communication are 32 input (RX) points (16 points for the PLC function), 32 output (RY) points (16 points for the PLC function), 4 remote register (RWr) points, and 4 remote register (RWw) points.

◆Remote I/O

PLC function device number	Remote output device number	Signal name
X30	RYn0	Forward rotation command
X31	RYn1	Reverse rotation command
X32	RYn2	High-speed operation command (Terminal RH function) *1
X33	RYn3	Middle-speed operation command (Terminal RM function) *1
X34	RYn4	Low-speed operation command (Terminal RL function) *1
X35	RYn5	JOG operation command (Terminal JOG function) *1
X36	RYn6	Second function selection (Terminal RT function) *1
X37	RYn7	Current input selection (Terminal AU function) *1
X38	RYn8	Selection of automatic restart after instantaneous power failure (Terminal CS function) *1
X39	RYn9	Output stop
X3A	RYnA	Start self-holding selection (Terminal STP (STOP) function) *1
X3B	RYnB	Reset (Terminal RES function) *1
X3C	RYnC	General-purpose remote input for PLC function
X3D	RYnD	
X3E	RYnE	
X3F	RYnF	
—	RY (n + 1) 0 to RY (n + 1) 7	Reserved

PLC function device number	Remote input device number	Signal name
Y30	RXn0	Forward rotating
Y31	RXn1	Reverse rotating
Y32	RXn2	Running (Terminal RUN function) *2
Y33	RXn3	Up to frequency (Terminal SU function) *2
Y34	RXn4	Overload alarm (Terminal OL function) *2
Y35	RXn5	Instantaneous power failure (Terminal IPF function) *2
Y36	RXn6	Frequency detection (Terminal FU function) *2
Y37	RXn7	Fault (Terminal ABC1 function) *2
Y38	RXn8	— (Terminal ABC2 function) *2
Y39	RXn9	**Pr.313** assignment function (DO0) *3
Y3A	RXnA	**Pr.314** assignment function (DO1) *3
Y3B	RXnB	**Pr.315** assignment function (DO2) *3
Y3C	RXnC	General-purpose remote input for PLC function
Y3D	RXnD	
Y3E	RXnE	
Y3F	RXnF	
—	RX (n + 1) 0 to RX (n + 1) 7	Reserved

PLC function device number	Remote output device number	Signal name
—	RY (n + 1) 8	Unused (Initial data process completion flag)
—	RY (n + 1) 9	Unused (Initial data process request flag)
—	RY (n + 1) A	Error reset request flag
—	RY (n + 1) B to RY (n + 1) F	Reserved

PLC function device number	Remote input device number	Signal name
—	RX (n + 1) 8	Unused (Initial data process request flag)
—	RX (n + 1) 9	Unused (Initial data process completion flag)
—	RX (n + 1) A	Error status flag
—	RX (n + 1) B	Remote station ready
—	RX (n + 1) C to RX (n + 1) F	Reserved

("n" indicates a value determined by the station number setting.)

*1 These signal names are initial values. The functions of input signals can be changed using **Pr.180 to Pr.186**, **Pr.188**, and **Pr.189**. The signals of RYn0, RYn1, and RYn9 cannot be changed. Signals changed using **Pr.178**, **Pr.179**, and **Pr.187** are invalid. For details on **Pr.178 to Pr.189**, refer to the Instruction Manual of the inverter.

*2 These signal names are initial values. The functions of output signals can be changed using **Pr.190 to Pr.196**. For details on **Pr.190 to Pr.196**, refer to the Instruction Manual of the inverter.

*3 Output signals can be assigned using **Pr.313 to Pr.315**. For details on the signals, refer to the description of **Pr.190 to Pr.196** in the Instruction Manual of the inverter.

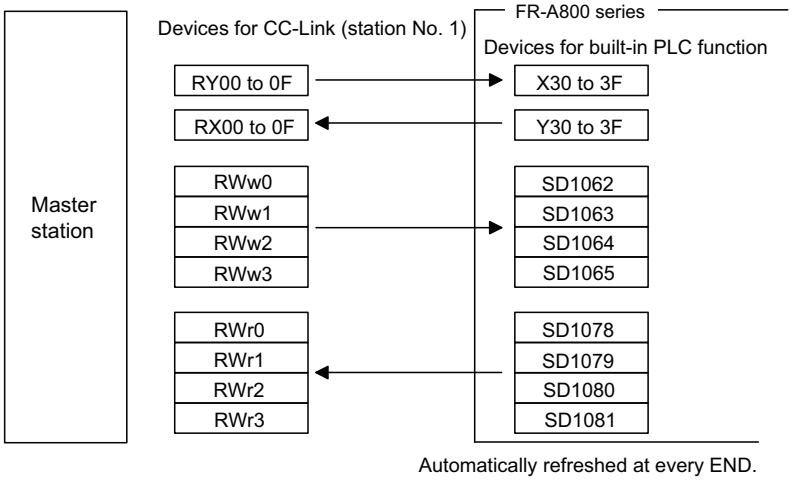
◆Remote register

PLC function device number	Address	Description
SD1062	RWwn	Registers for reading data received from the master station.
SD1063	RWwn + 1	
SD1064	RWwn + 2	
SD1065	RWwn + 3	

PLC function device number	Address	Description
SD1078	RWrn	Registers for writing data to be sent to the master station.
SD1079	RWrn + 1	
SD1080	RWrn + 2	
SD1081	RWrn + 3	

("n" indicates a value determined by the station number setting.)

◆I/O figure



NOTE

• All remote registers are user areas and can be used freely.

2.3.2 I/O signals when the double setting is set in CC-Link Ver.2 (Pr.544 = "112")

The number of device points available in CC-Link communication are 32 input (RX) points (12 points for the PLC function), 32 output (RY) points (12 points for the PLC function), 4 remote register (RWr) points, and 4 remote register (RWw) points.

◆Remote I/O

PLC function device number	Remote output device number	Signal name
X30	RYn0	Forward rotation command
X31	RYn1	Reverse rotation command
X32	RYn2	High-speed operation command (Terminal RH function) *1
X33	RYn3	Middle-speed operation command (Terminal RM function) *1
X34	RYn4	Low-speed operation command (Terminal RL function) *1
X35	RYn5	JOG operation command (Terminal JOG function) *1
X36	RYn6	Second function selection (Terminal RT function) *1
X37	RYn7	Current input selection (Terminal AU function) *1
X38	RYn8	Selection of automatic restart after instantaneous power failure (Terminal CS function) *1
X39	RYn9	Output stop
X3A	RYnA	Start self-holding selection (Terminal STP (STOP) function) *1
X3B	RYnB	Reset (Terminal RES function) *1
—	RYnC	Monitor command
—	RYnD	Frequency setting command (RAM)
—	RYnE	Frequency setting command (RAM, EEPROM)
—	RYnF	Instruction code execution request

PLC function device number	Remote input device number	Signal name
Y30	RXn0	Forward rotating
Y31	RXn1	Reverse rotating
Y32	RXn2	Running (Terminal RUN function) *2
Y33	RXn3	Up to frequency (Terminal SU function) *2
Y34	RXn4	Overload alarm (Terminal OL function) *2
Y35	RXn5	Instantaneous power failure (Terminal IPF function) *2
Y36	RXn6	Frequency detection (Terminal FU function) *2
Y37	RXn7	Fault (Terminal ABC1 function) *2
Y38	RXn8	— (Terminal ABC2 function) *2
Y39	RXn9	**Pr.313** assignment function (DO0) *3
Y3A	RXnA	**Pr.314** assignment function (DO1) *3
Y3B	RXnB	**Pr.315** assignment function (DO2) *3
—	RXnC	Monitoring
—	RXnD	Frequency setting completion (RAM)
—	RXnE	Frequency setting completion (RAM, EEPROM)
—	RXnF	Instruction code execution completion

PLC function device number	Remote output device number	Signal name
—	RY (n + 1) 0 to RY (n + 1) 7	Reserved
—	RY (n + 1) 8	Unused (Initial data process completion flag)
—	RY (n + 1) 9	Unused (Initial data process request flag)
—	RY (n + 1) A	Error reset request flag
—	RY (n + 1) B to RY (n + 1) F	Reserved

PLC function device number	Remote input device number	Signal name
—	RX (n + 1) 0 to RX (n + 1) 7	Reserved
—	—	Unused (Initial data process request flag)
—	RX (n + 1) 9	Unused (Initial data process completion flag)
—	RX (n + 1) A	Error status flag
—	RX (n + 1) B	Remote station ready
	RX (n + 1) C to RX (n + 1) F	Reserved

("n" indicates a value determined by the station number setting.)

∗1 These signal names are initial values. The functions of input signals can be changed using **Pr.180 to Pr.186**, **Pr.188, and Pr.189**. The signals of RYn0, RYn1, and RYn9 cannot be changed. Signals changed using **Pr.178, Pr.179**, and **Pr.187** are invalid. For details on **Pr.178 to Pr.189**, refer to the Instruction Manual of the inverter.

∗2 These signal names are initial values. The functions of output signals can be changed using **Pr.190 to Pr.196**. For details on **Pr.190 to Pr.196**, refer to the Instruction Manual of the inverter.

∗3 Output signals can be assigned using **Pr.313 to Pr.315**. For details on the signals, refer to the description of **Pr.190 to Pr.196** in the Instruction Manual of the inverter.

◆Remote register

PLC function device number	Address	Description	
		Upper 8 bits	Lower 8 bits
—	RWwn	Monitor code 2	Monitor code 1
—	RWwn + 1	Set frequency/torque command∗1 (0.01 Hz increments)	
—	RWwn + 2	Link parameter extended setting	Instruction code
—	RWwn + 3	Write data	
SD1062	RWwn + 4	Registers for reading data received from the master station.	
SD1063	RWwn + 5		
SD1064	RWwn + 6		
SD1065	RWwn + 7		

PLC function device number	Address	Description	
		Upper 8 bits	Lower 8 bits
—	RWrn	First monitor value	
—	RWrn + 1	Second monitor value	
—	RWrn + 2	Reply code 2	Reply code 1
—	RWrn + 3	Read data	
SD1078	RWrn + 4	Registers for writing data to be sent to the master station.	
SD1079	RWrn + 5		
SD1080	RWrn + 6		
SD1081	RWrn + 7		

("n" indicates a value determined by the station number setting.)

∗1 Under vector control (torque control) (**Pr.804** = "3, 5")

2.3.3 I/O signals when the quadruple setting is set in CC-Link Ver.2 (Pr. 544 = "114")

The number of device points available in CC-Link communication are 32 input (RX) points (12 points for the PLC function), 32 output (RY) points (12 points for the PLC function), 8 remote register (RWr) points, and 8 remote register (RWw) points.

◆Remote I/O

Same as when **Pr.544** = "112". (Refer to **page 59.**)

◆Remote register

PLC function device number	Address	Description	
		Upper 8 bits	Lower 8 bits
—	RWwn	Monitor code 2	Monitor code 1
—	RWwn + 1	Set frequency/torque command *1 (0.01 Hz increments)	
—	RWwn + 2	Link parameter extended setting	Instruction code
—	RWwn + 3	Write data	
—	RWwn + 4	Monitor code 3	
—	RWwn + 5	Monitor code 4	
—	RWwn + 6	Monitor code 5	
—	RWwn + 7	Monitor code 6	
SD1062	RWwn + 8	Registers for reading data received from the master station.	
SD1063	RWwn + 9		
SD1064	RWwn + A		
SD1065	RWwn + B		
SD1066	RWwn + C		
SD1067	RWwn + D		
SD1068	RWwn + E		
SD1069	RWwn + F		

PLC function device number	Address	Description	
		Upper 8 bits	Lower 8 bits
—	RWrn	First monitor value	
—	RWrn + 1	Second monitor value	
—	RWrn + 2	Reply code 2	Reply code 1
—	RWrn + 3	Read data	
—	RWrn + 4	Third monitor value	
—	RWrn + 5	Fourth monitor value	
—	RWrn + 6	Fifth monitor value	
—	RWrn + 7	Sixth monitor value	
SD1078	RWrn + 8	Registers for writing data to be sent to the master station.	
SD1079	RWrn + 9		
SD1080	RWrn + A		
SD1081	RWrn + B		
SD1082	RWrn + C		
SD1083	RWrn + D		
SD1084	RWrn + E		
SD1085	RWrn + F		

("n" indicates a value determined by the station number setting.)

*1 Under vector control (torque control) (**Pr.804** = "3, 5")

2.3.4 I/O signals when the octuple setting is set in CC-Link Ver.2 (Pr. 544 = "118")

The number of device points available in CC-Link communication are 32 input (RX) points (12 points for the PLC function), 32 output (RY) points (12 points for the PLC function), 16 remote register (RWr) points, and 16 remote register (RWw) points.

◆Remote I/O

Same as when **Pr.544** = 112. (Refer to page 59.)

◆Remote register

PLC function device number	Address	Description	
		Upper 8 bits	Lower 8 bits
—	RWwn	Monitor code 2	Monitor code 1
—	RWwn + 1	Set frequency (0.01 Hz increments)	
—	RWwn + 2	Link parameter extended setting	Instruction code
—	RWwn + 3	Write data	
—	RWwn + 4	Monitor code 3	
—	RWwn + 5	Monitor code 4	
—	RWwn + 6	Monitor code 5	
—	RWwn + 7	Monitor code 6	
—	RWwn + 8	Fault record number	H00
—	RWwn + 9	PID set point (0.01% increments) *1	
—	RWwn + A	PID measured value (0.01% increments) *2	
—	RWwn + B	PID deviation (0.01% increments) *3	
—	RWwn + C	Reserved	
—	RWwn + D	H00 (Empty)	
—	RWwn + E		
—	RWwn + F		

PLC function device number	Address	Description	
		Upper 8 bits	Lower 8 bits
—	RWrn	First monitor value	
—	RWrn + 1	Second monitor value	
—	RWrn + 2	Reply code 2	Reply code 1
—	RWrn + 3	Read data	
—	RWrn + 4	Third monitor value	
—	RWrn + 5	Fourth monitor value	
—	RWrn + 6	Fifth monitor value	
—	RWrn + 7	Sixth monitor value	
—	RWrn + 8	Fault record number	Fault record data
—	RWrn + 9	Fault record (Output frequency)	
—	RWrn + A	Fault record (Output current)	
—	RWrn + B	Fault record (Output voltage)	
—	RWrn + C	Fault record (Energization time)	
—	RWrn + D	H00 (Empty)	
—	RWrn + E		
—	RWrn + F		

*1 Valid when **Pr.128** = "40, 41, 60, 61, 140, or 141".
*2 Valid when **Pr.128** = "60 or 61".
*3 Valid when **Pr.128** = "50 or 51".

PLC function device number	Address	Description	
		Upper 8 bits	Lower 8 bits
SD1062	RWwn + 10	Registers for reading data received from the master station.	
SD1063	RWwn + 11		
SD1064	RWwn + 12		
SD1065	RWwn + 13		
SD1066	RWwn + 14		
SD1067	RWwn + 15		
SD1068	RWwn + 16		
SD1069	RWwn + 17		
SD1070	RWwn + 18		
SD1071	RWwn + 19		
SD1072	RWwn + 1A		
SD1073	RWwn + 1B		
SD1074	RWwn + 1C		
SD1075	RWwn + 1D		
SD1076	RWwn + 1E		
SD1077	RWwn + 1F		

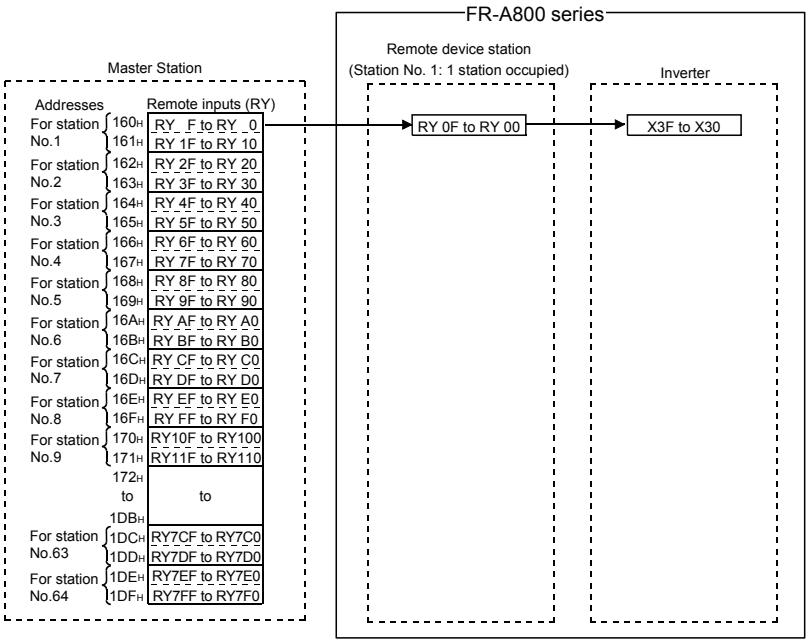
PLC function device number	Address	Description	
		Upper 8 bits	Lower 8 bits
SD1078	RWrn + 10	Registers for writing data to be sent to the master station.	
SD1079	RWrn + 11		
SD1080	RWrn + 12		
SD1081	RWrn + 13		
SD1082	RWrn + 14		
SD1083	RWrn + 15		
SD1084	RWrn + 16		
SD1085	RWrn + 17		
SD1086	RWrn + 18		
SD1087	RWrn + 19		
SD1088	RWrn + 1A		
SD1089	RWrn + 1B		
SD1090	RWrn + 1C		
SD1091	RWrn + 1D		
SD1092	RWrn + 1E		
SD1093	RWrn + 1F		

("n" indicates a value determined by the station number setting.)

2.4 Buffer memory

2.4.1 Remote output signals (master station to inverter (FR-A8NC))

- Input statuses to the remote device station are stored.
- Each station uses two words.
  (Do not use address 16n (n = 2 (X - 1) + 1, X = station number).)

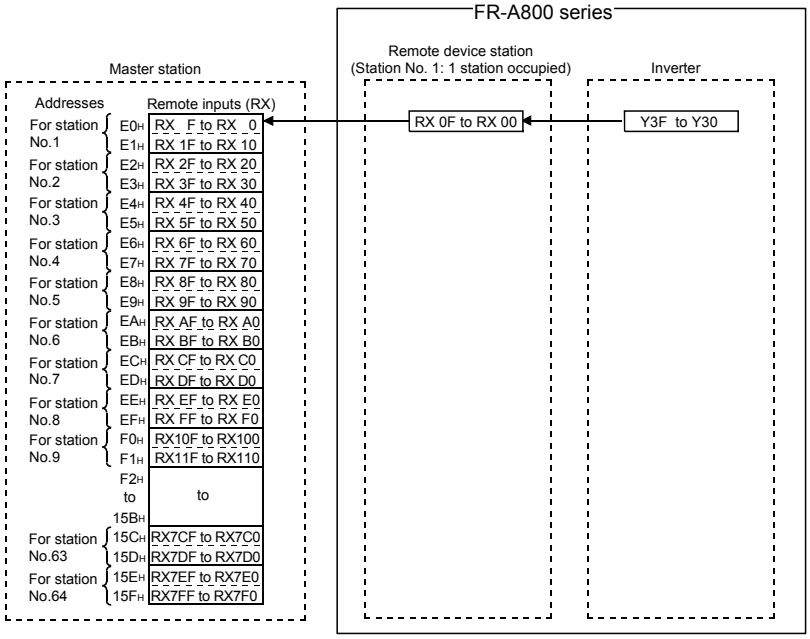


Correspondence table of buffer memory addresses and station numbers of the master station

Station number	Buffer memory address	Station number	Buffer memory address	Station number	Buffer memory address	Station number	Buffer memory address
1	160H	17	180H	33	1A0H	49	1C0H
2	162H	18	182H	34	1A2H	50	1C2H
3	164H	19	184H	35	1A4H	51	1C4H
4	166H	20	186H	36	1A6H	52	1C6H
5	168H	21	188H	37	1A8H	53	1C8H
6	16AH	22	18AH	38	1AAH	54	1CAH
7	16CH	23	18CH	39	1ACH	55	1CCH
8	16EH	24	18EH	40	1AEH	56	1CEH
9	170H	25	190H	41	1B0H	57	1D0H
10	172H	26	192H	42	1B2H	58	1D2H
11	174H	27	194H	43	1B4H	59	1D4H
12	176H	28	196H	44	1B6H	60	1D6H
13	178H	29	198H	45	1B8H	61	1D8H
14	17AH	30	19AH	46	1BAH	62	1DAH
15	17CH	31	19CH	47	1BCH	63	1DCH
16	17EH	32	19EH	48	1BEH	64	1DEH

2.4.2 Remote input signals Pr.544 = "100" (inverter (FR-A8NC) to master station)

- Input statuses from the remote device station are stored.
- Each station uses two words.
  (Do not use address En (n = 2 (X - 1) + 1, X = station number).)

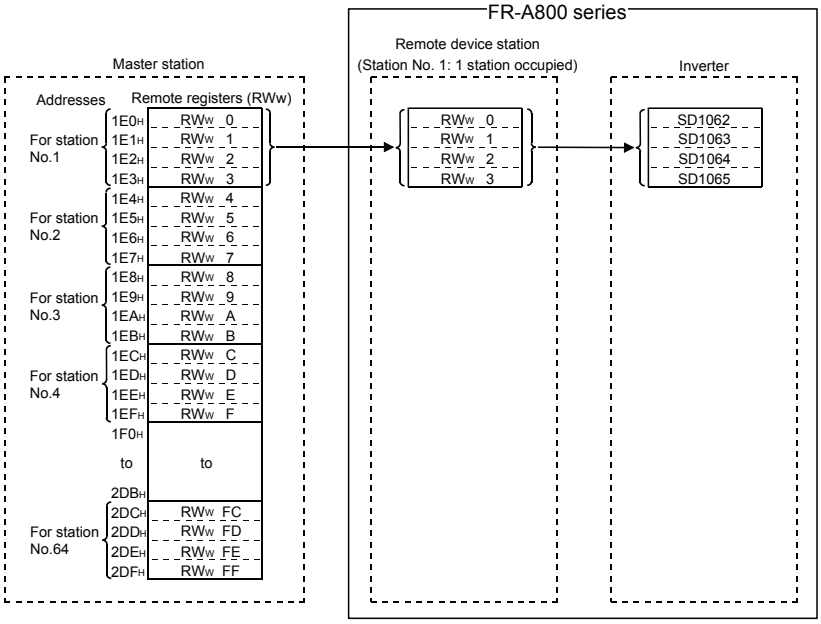

FR-A800 series
Remote device station
(Station No. 1: 1 station occupied)
Inverter
Master station
Addresses
Remote inputs (RX)
RX 0F to RX 00
Y3F to Y30
For station No.1
E0H RX F to RX 0
E1H RX 1F to RX 10
For station No.2
E2H RX 2F to RX 20
E3H RX 3F to RX 30
For station No.3
E4H RX 4F to RX 40
E5H RX 5F to RX 50
For station No.4
E6H RX 6F to RX 60
E7H RX 7F to RX 70
For station No.5
E8H RX 8F to RX 80
E9H RX 9F to RX 90
For station No.6
EAH RX AF to RX A0
EBH RX BF to RX B0
For station No.7
ECH RX CF to RX C0
EDH RX DF to RX D0
For station No.8
EEH RX EF to RX E0
EFH RX FF to RX F0
For station No.9
F0H RX10F to RX100
F1H RX11F to RX110
F2H to 15BH to
For station No.63
15CH RX7CF to RX7C0
15DH RX7DF to RX7D0
For station No.64
15EH RX7EF to RX7E0
15FH RX7FF to RX7F0

Correspondence table of buffer memory addresses and station numbers of the master station

Station number	Buffer memory address	Station number	Buffer memory address	Station number	Buffer memory address	Station number	Buffer memory address
1	E0H	17	100H	33	120H	49	140H
2	E2H	18	102H	34	122H	50	142H
3	E4H	19	104H	35	124H	51	144H
4	E6H	20	106H	36	126H	52	146H
5	E8H	21	108H	37	128H	53	148H
6	EAH	22	10AH	38	12AH	54	14AH
7	ECH	23	10CH	39	12CH	55	14CH
8	EEH	24	10EH	40	12EH	56	14EH
9	F0H	25	110H	41	130H	57	150H
10	F2H	26	112H	42	132H	58	152H
11	F4H	27	114H	43	134H	59	154H
12	F6H	28	116H	44	136H	60	156H
13	F8H	29	118H	45	138H	61	158H
14	FAH	30	11AH	46	13AH	62	15AH
15	FCH	31	11CH	47	13CH	63	15CH
16	FEH	32	11EH	48	13EH	64	15EH

2.4.3 Remote registers Pr.544 = "100" (master station to inverter (FR-A8NC))

- Data to be sent to remote registers (RWw) of the remote device station are stored.
- Each station uses four words.

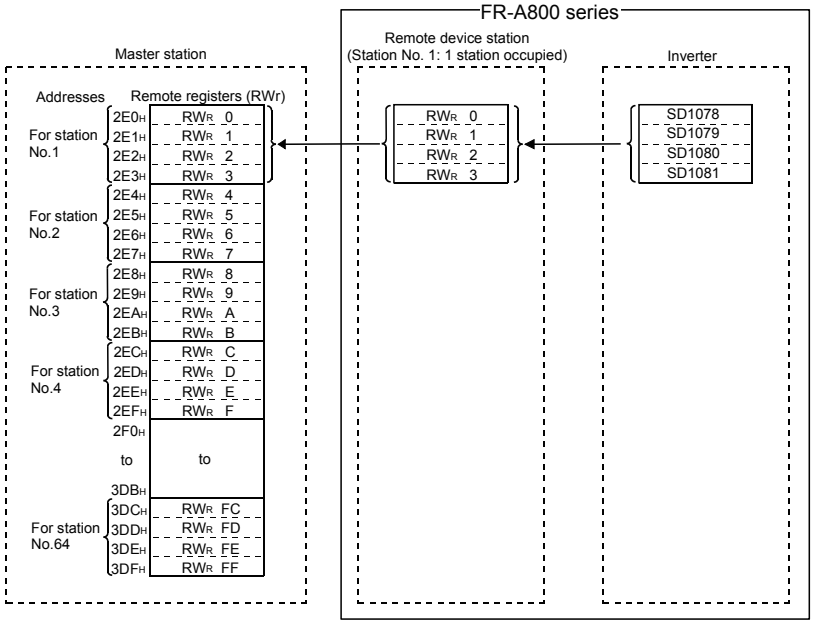


Correspondence table of buffer memory addresses and station numbers of the master station

Station number	Buffer memory address	Station number	Buffer memory address	Station number	Buffer memory address	Station number	Buffer memory address
1	1E0H to 1E3H	17	220H to 223H	33	260H to 263H	49	2A0H to 2A3H
2	1E4H to 1E7H	18	224H to 227H	34	264H to 267H	50	2A4H to 2A7H
3	1E8H to 1EBH	19	228H to 22BH	35	268H to 26BH	51	2A8H to 2ABH
4	1ECH to 1EFH	20	22CH to 22FH	36	26CH to 26FH	52	2ACH to 2AFH
5	1F0H to 1F3H	21	230H to 233H	37	270H to 273H	53	2B0H to 2B3H
6	1F4H to 1F7H	22	234H to 237H	38	274H to 277H	54	2B4H to 2B7H
7	1F8H to 1FBH	23	238H to 23BH	39	278H to 27BH	55	2B8H to 2BBH
8	1FCH to 1FFH	24	23CH to 23FH	40	27CH to 27FH	56	2BCH to 2BFH
9	200H to 203H	25	240H to 243H	41	280H to 283H	57	2C0H to 2C3H
10	204H to 207H	26	244H to 247H	42	284H to 287H	58	2C4H to 2C7H
11	208H to 20BH	27	248H to 24BH	43	288H to 28BH	59	2C8H to 2CBH
12	20CH to 20FH	28	24CH to 24FH	44	28CH to 28FH	60	2CCH to 2CFH
13	210H to 213H	29	250H to 253H	45	290H to 293H	61	2D0H to 2D3H
14	214H to 217H	30	254H to 257H	46	294H to 297H	62	2D4H to 2D7H
15	218H to 21BH	31	258H to 25BH	47	298H to 29BH	63	2D8H to 2DBH
16	21CH to 21FH	32	25CH to 25FH	48	29CH to 29FH	64	2DCH to 2DFH

2.4.4 Remote registers Pr.544 = "100" (inverter (FR-A8NC) to master station)

- Data sent from the remote registers (RWr) of the remote device station are stored.
- Each station uses four words.



Correspondence table of buffer memory addresses and station numbers of the master station

Station number	Buffer memory address	Station number	Buffer memory address	Station number	Buffer memory address	Station number	Buffer memory address
1	2E0H to 2E3H	17	320H to 323H	33	360H to 363H	49	3A0H to 3A3H
2	2E4H to 2E7H	18	324H to 327H	34	364H to 367H	50	3A4H to 3A7H
3	2E8H to 2EBH	19	328H to 32BH	35	368H to 36BH	51	3A8H to 3ABH
4	2ECH to 2EFH	20	32CH to 32FH	36	36CH to 36FH	52	3ACH to 3AFH
5	2F0H to 2F3H	21	330H to 333H	37	370H to 373H	53	3B0H to 3B3H
6	2F4H to 2F7H	22	334H to 337H	38	374H to 377H	54	3B4H to 3B7H
7	2F8H to 2FBH	23	338H to 33BH	39	378H to 37BH	55	3B8H to 3BBH
8	2FCH to 2FFH	24	33CH to 33FH	40	37CH to 37FH	56	3BCH to 3BFH
9	300H to 303H	25	340H to 343H	41	380H to 383H	57	3C0H to 3C3H
10	304H to 307H	26	344H to 347H	42	384H to 387H	58	3C4H to 3C7H
11	308H to 30BH	27	348H to 34BH	43	388H to 38BH	59	3C8H to 3CBH
12	30CH to 30FH	28	34CH to 34FH	44	38CH to 38FH	60	3CCH to 3CFH
13	310H to 313H	29	350H to 353H	45	390H to 393H	61	3D0H to 3D3H
14	314H to 317H	30	354H to 357H	46	394H to 397H	62	3D4H to 3D7H
15	318H to 31BH	31	358H to 35BH	47	398H to 39BH	63	3D8H to 3DBH
16	31CH to 31FH	32	35CH to 35FH	48	39CH to 39FH	64	3DCH to 3DFH

MEMO

3 Sequence program

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3.1 Overview

3.1.1 Overview of operation

The following description is of the overview of processing performed after the inverter is turned ON and through to execution of a sequence program.
PLC function processing can roughly be classified into the following three types.

◆Initial processing

Initial processing is pre-processing to execute sequence operations and is performed only once when the inverter is turned ON or reset.

- Resets to initialize the input and output.
- Initializes the data memory (bit devices are turned OFF and word devices are set to 0).
- Performs self-diagnostic checks on such items as PLC function parameter settings and operation circuits.

NOTE

- PLC function can be checked via FR Configurator2 (Developer). (Refer to the Instruction Manual of FR Configurator2.)

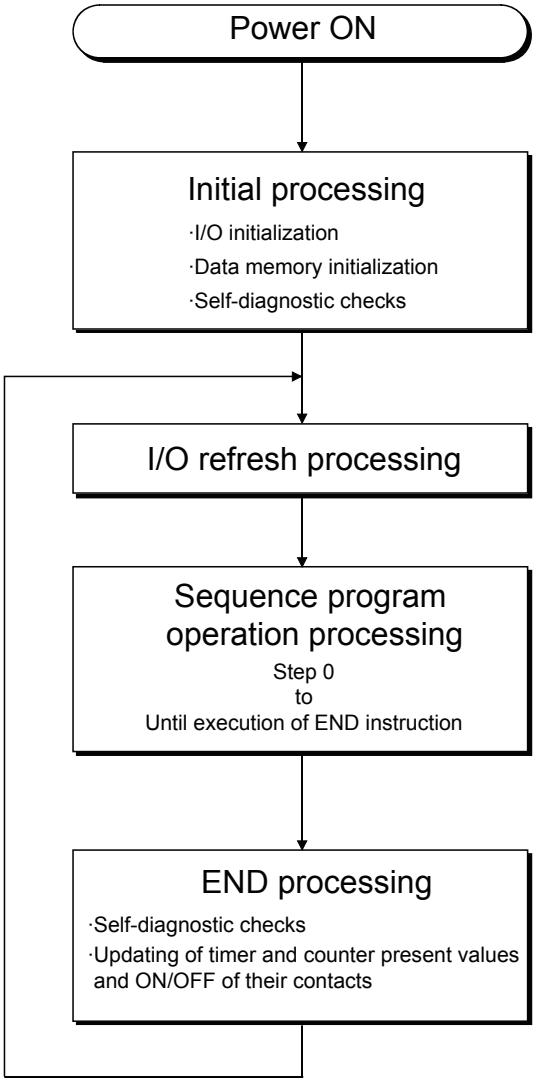
◆Sequence program operation

Executes a sequence program written in the PLC function from step 0 through the END instruction.

◆END processing

End processing is post-processing to end operation processing of a sequence program once and return execution to step 0 in the sequence program.

- Performs a self-diagnostic check.
- Updates timers and counters to the present values and turns contacts on/off.


Power ON
Initial processing
·I/O initialization
·Data memory initialization
·Self-diagnostic checks
I/O refresh processing
Sequence program operation processing
Step 0
to
Until execution of END instruction
END processing
·Self-diagnostic checks
·Updating of timer and counter present values and ON/OFF of their contacts

3.2 RUN/STOP operation

The PLC function has two operating statuses, a RUN state and a STOP state.
The following description is of operation processing of the PLC function in each state.

◆RUN state operation

In the RUN state, the PLC function operates a sequence program in the sequence of step 0→END (FEND) instruction→step 0 repeatedly when the SQ signal is turned ON. (P.RUN is ON)
The output suspended in the STOP state is executed according to the PLC function parameter output mode set for STOP→RUN switching (refer to page 99) when the PLC function enters the RUN state.

◆STOP state operation

In the STOP state, the PLC function stops operating a sequence program when the SQ signal is turned OFF or the inverter is stopped remotely. (P.RUN is OFF)
The PLC function saves the output status and turns off all output points when it enters the STOP state. Data other than the output (Y) is retained in the memory.

POINT

- The PLC function performs I/O refresh processing in both RUN and STOP states. Therefore, input/output can be monitored and tested from peripheral devices even in the STOP state.

3.3 Program configuration

◆Program classification

Programs that can be used in the PLC function are main sequence programs only. Microcomputer programs, interrupt programs, and SFC programs cannot be used.

◆Program capacity

The program capacity is the memory capacity that stores programs and is 6k steps (24k bytes). Set the program capacity using PLC function parameters (PLC parameters).

3.4 Programming language

Programming the PLC function can be performed through two methods. One uses figures and the other uses dedicated instructions.

- Programming with figures is performed by using the relay symbolic language. (Programming in FR Configurator2 (Developer) is performed in "ladder mode.")
- Programming with dedicated instructions is performed by using the logic symbolic language. (Programming that uses FR Configurator2 (Developer) is performed in "list mode.")

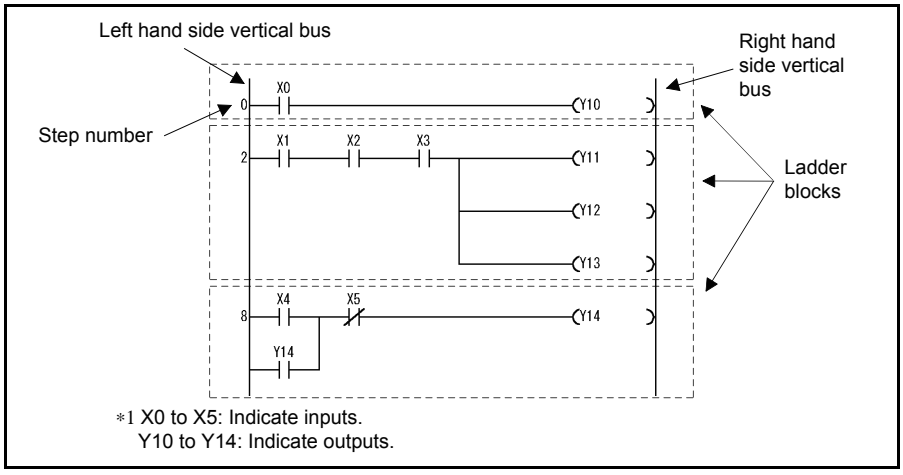
The same program is created with both the relay symbolic language and the logic symbolic language.

3.4.1 Relay symbolic language (ladder mode)

The relay symbolic language is based on the concept of relay control circuits.
This language allows programming through expressions similar to sequential circuits in relay control.

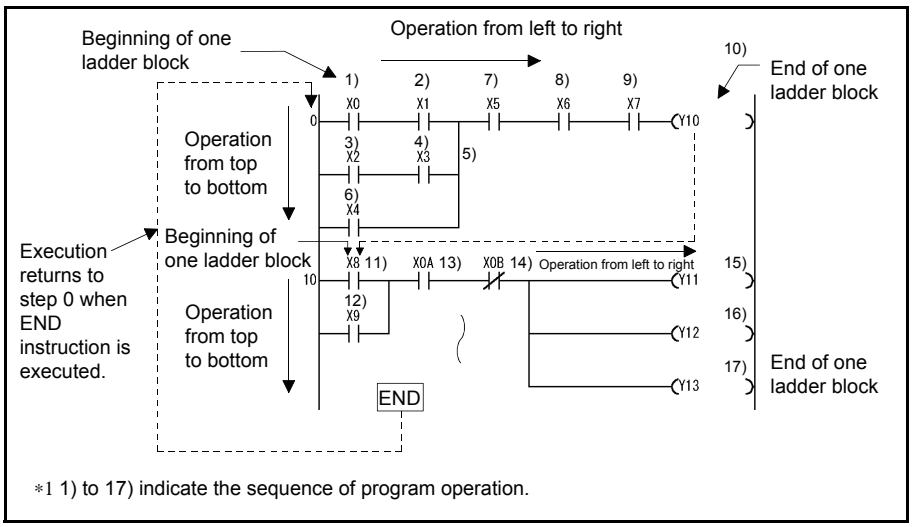
◆Ladder block

A ladder block is the smallest elements for the sequence program operation, and starts at a vertical rail on the left side and ends at the one on the right side.



◆Sequence program operation method

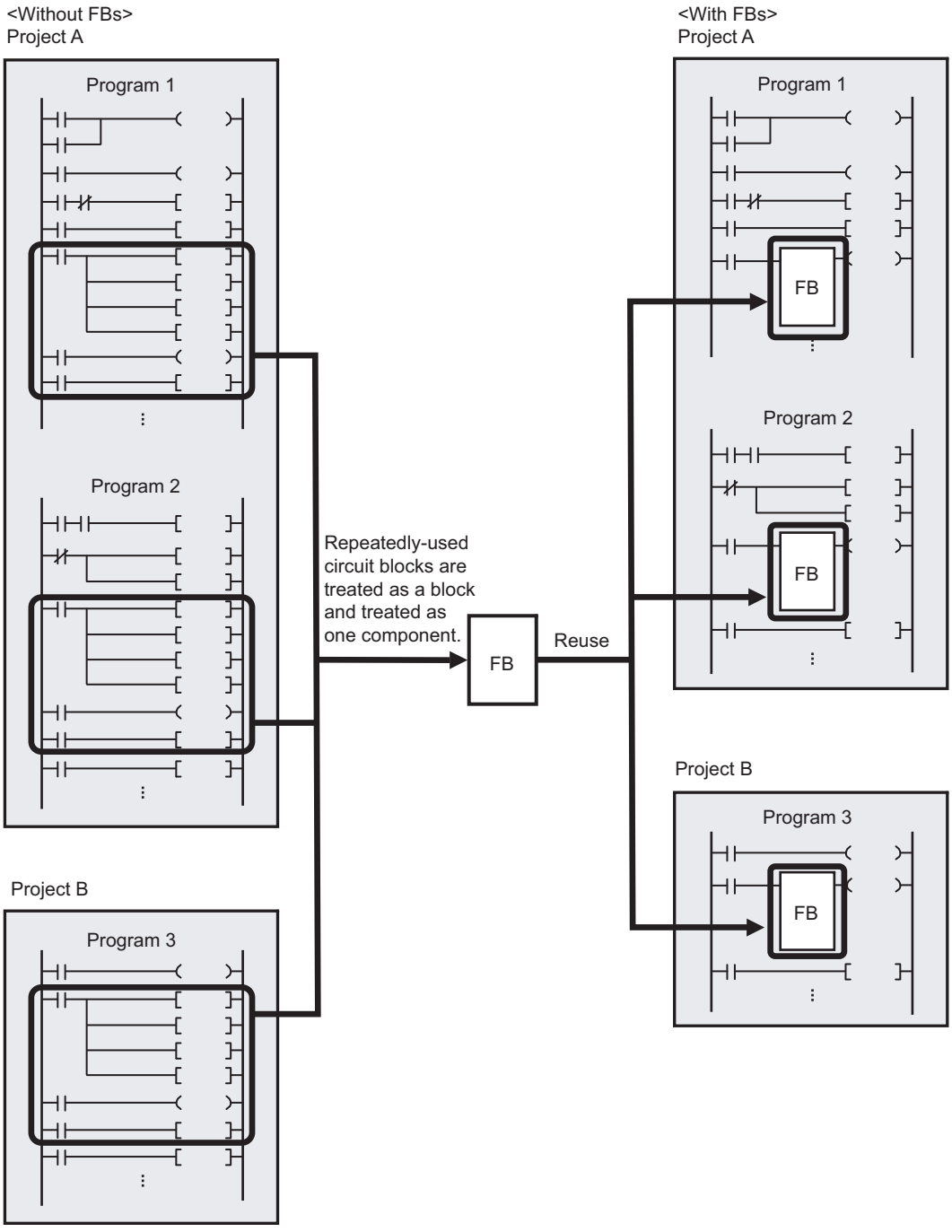
The sequence program is operated repeatedly from the ladder block at step 0 through the END instruction.
A ladder block is operated from the left vertical rail to the right vertical rail and from top down.



∗1 1) to 17) indicate the sequence of program operation.

3.4.2 Function block (FB)

A function block (FB) is a repeatedly used ladder blocks that is treated as a component so that it can also be used in other sequence programs.



3.5 Operation processing method of the PLC function

The PLC function uses the repetitive operation method of stored programs.

◆Stored program method

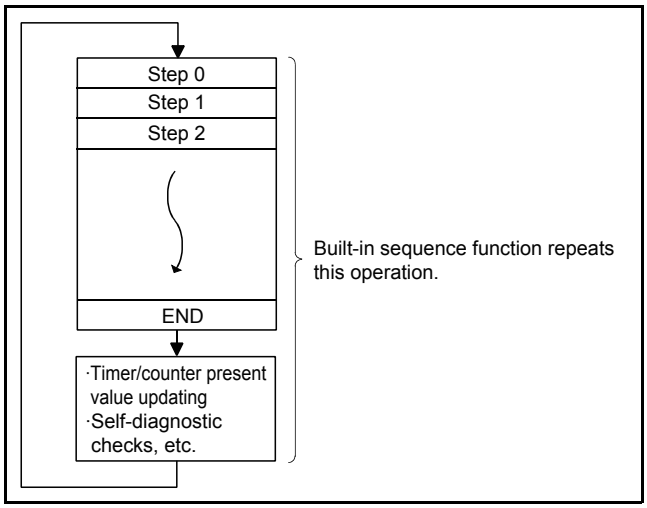
- The stored program method stores a sequence program to be operated in the internal memory in advance.
- At execution of the sequence program, the sequence program stored in the PLC function is read to the CPU by each instruction in order to execute operations, and that result is used to control each device status.

◆Repetitive operation method

The repetitive operation method executes a sequence of operations repeatedly.

The PLC function executes the following process repeatedly.

- The PLC function executes a sequence program stored in the internal memory in sequence from step 0.
- The PLC function performs internal processing such as updating timers/counters to the present values and performing self-diagnostic checks after executing the END instruction, and returns to step 0 in the sequence program.



NOTE

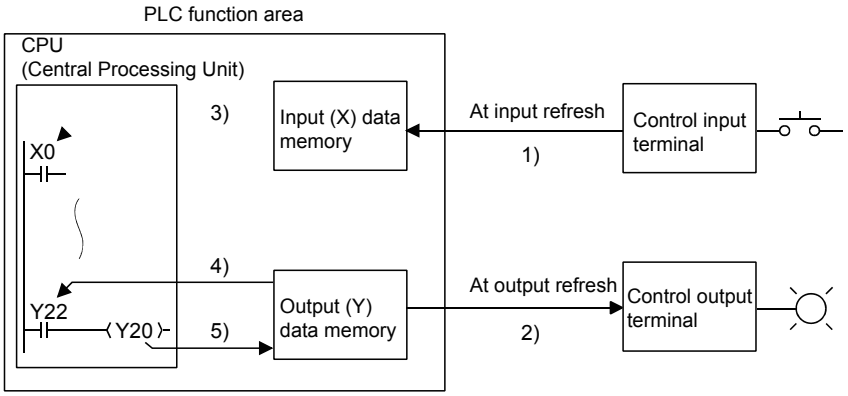
- Processing from step 0 to the next step 0 or END to the next END is called a scan.
  Therefore, a single scan time is the total time to process a user-created program (step 0 through END) and the time for internal processing of the PLC function.

3.6 I/O processing method

The control method is a refresh method.

3.6.1 Refresh method

The refresh method stores changes in the control input terminals to the CPU input data memory in batch before every scan is executed and uses the data stored in this input data memory for operation execution.
Program operation results of the output (Y) are output to the output data memory every time, and contents stored in the output data memory are output in batch from the control output terminals after the END instruction is executed.

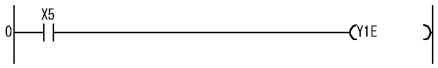


- Input refresh
  Input information is read 1) in batch from the PLC function area and stored in the input data memory (X) before executing step 0.
- Output refresh
  Output information 2) stored in the output data memory (Y) is output in batch to the PLC function area before executing step 0.
- When executing a contact instruction for the input
  Input information is read 3) from the input data memory (X) to execute a sequence program.
- When executing a contact instruction for the output
  Output information is read 4) from the output data memory (Y) to execute a sequence program.
- When executing an OUT instruction for the output
  Operation result of the sequence program 5) is stored in the output data memory (Y).

3.6.2 Response delay in refresh mode

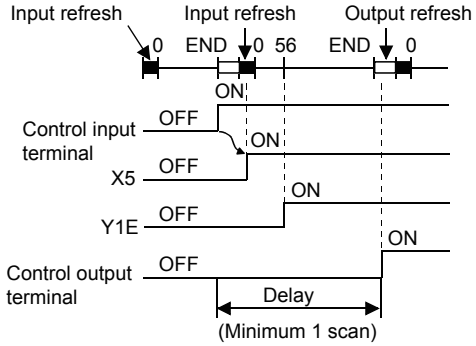
The following description is about the output delay for the varied inputs.
As shown in the figures below, change in the output lags behind that in the input by up to two scans.

Ladder example



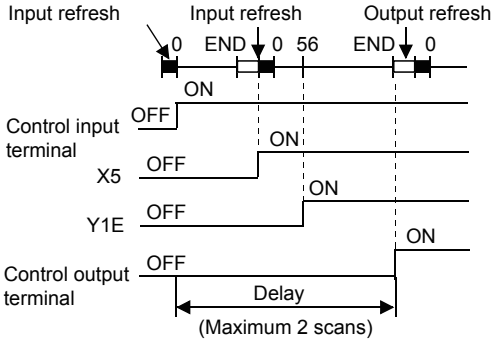
In this ladder, output Y1E turns ON when input X5 turns ON.

◆When Y1E turns ON at the earliest timing



The Y1E output turns ON at the earliest timing when the control input terminal turns ON immediately before the refresh. In this case, X5 turns ON at input refresh, Y1E turns ON at step 0, and then the control output terminal turns ON at output refresh after END instruction execution.
Therefore, change in the control output terminal occurs one scan behind that in the control input terminal.

◆When Y1E turns ON at the latest timing

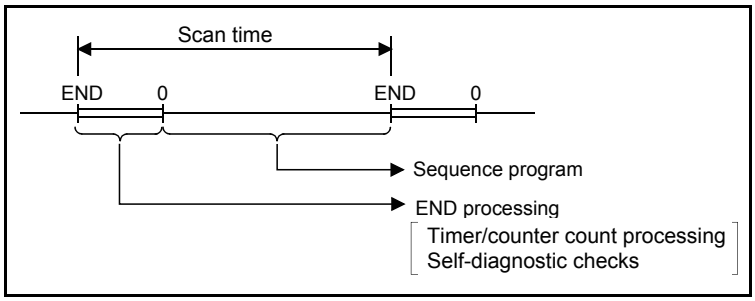


The Y1E output turns ON at the latest timing when the control input terminal turns ON immediately after the refresh. In this case, X5 turns ON at the next input refresh, Y1E turns ON at step 0, and then the control output terminal turns ON at the output refresh after END instruction execution.
Therefore, change in the control output terminal occurs two scans behind that in the control input terminal.

3.7 Scan time

◆Scan time

Scan time is the time period from operation execution of a sequence program from step 0 until executing the next step 0.
The scan time is not constant in every scan but differs according to whether instructions used are executed or not.



◆Scan time check

The scan time from the END instruction to the next END instruction is measured inside the programmable controller and stored in special registers SD520 (SD521), SD524 (SD525), and SD526 (SD527).

Device number	Name	Description
SD520	Current scan time	The scan time is stored at every END and is constantly updated. SD520: Stores the ms places (Stored range: 0 to 65535) SD521: Stores the μs places (Stored range: 0 to 900)
SD521		
SD524	Minimum scan time	The minimum scan time is stored at every END. SD524: Stores the ms places (Stored range: 0 to 65535) SD525: Stores the μs places (Stored range: 0 to 900)
SD525		
SD526	Maximum scan time	The maximum scan time is stored at every END. SD526: Stores the ms places (Stored range: 0 to 65535) SD527: Stores the μs places (Stored range: 0 to 900)
SD527		

- Scan time accuracy

  The accuracy of the scan time observed inside the programmable controller is ±2 ms.

  For example, the actual scan time is within the range of 3 ms to 7 ms when data stored in SD520 is 5.

3.8 Values that can be used in sequence programs

For the PLC function, data such as values and alphabetical characters are represented in two statuses, 0 (OFF) and 1 (ON).
Data represented with 0 and 1 is called BIN (binary).
The PLC function can also use HEX (hexadecimal), which represents four bits of BIN data together.
The following table shows the numeric representations in BIN (binary), HEX (hexadecimal), and DEC (decimal).

DEC (decimal)	HEX (hexadecimal)	BIN (binary)
0	0	0
1	1	1
2	2	10
3	3	11
.	.	.
.	.	.
.	.	.
.	.	.
.	.	.
.	.	.
9	9	1001
10	A	1010
11	B	1011
12	C	1100
13	D	1101
14	E	1110
15	F	1111
16	10	10000
17	11	10001
.	.	.
.	.	.
.	.	.
.	.	.
.	.	.
.	.	.
47	2F	101111

3.8.1 BIN (binary)

◆Binary

BIN represents a value with 0 (OFF) and 1 (ON).

In decimal notation, when a value increases from 0 to 9, a carry occurs and the next value becomes 10.

In BIN (binary) notation, a carry is generated after 0 and 1, and the next value becomes 10 (2 in decimal notation).

The following table shows the binary and decimal numeric representations.

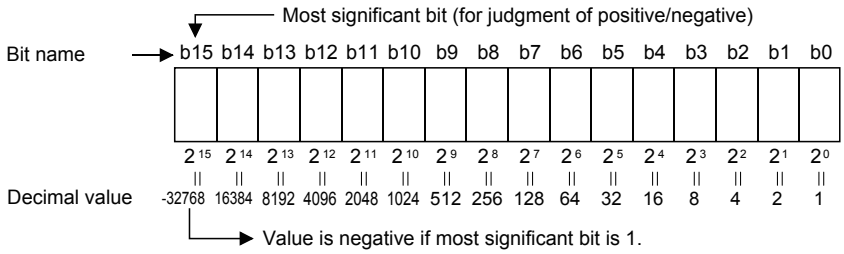
DEC (decimal)	BIN (binary)	
0	0000	
1	0001	Carry
2	0010	
3	0011	Carry
4	0100	
5	0101	
6	0110	
7	0111	Carry
8	1000	
9	1001	
10	1010	
11	1011	

◆Numeric representation in BIN (binary)

Each register (such as a data register) used for the PLC function consists of 16 bits.

- Most significant bit is 0 ... Positive
- Most significant bit is 1 ... Negative

The following figure shows the numeric representation of each register used for the PLC function.


Most significant bit (for judgment of positive/negative)
Bit name
b15 b14 b13 b12 b11 b10 b9 b8 b7 b6 b5 b4 b3 b2 b1 b0
2^15 2^14 2^13 2^12 2^11 2^10 2^9 2^8 2^7 2^6 2^5 2^4 2^3 2^2 2^1 2^0
Decimal value
-32768 16384 8192 4096 2048 1024 512 256 128 64 32 16 8 4 2 1
Value is negative if most significant bit is 1.

Numerical data that can be used for the PLC function

In the numeric representation shown in the figure above, values can be represented in the range from -32768 to 32767.

Therefore, each register used for the PLC function can store a value between -32768 and 32767.

3.8.2 HEX (hexadecimal)

◆HEX

HEX represents four bits of binary data with one digit.

BIN uses 4 bits to represent the 16 values from 0 to 15.

HEX uses the letter A to represent the bit next to 9 (10) and B to represent 11, and then a carry occurs after F (15).

For the numeric representations of BIN, HEX, and DEC, refer to **page 80**.

◆Numeric representation in HEX

Each register (such as a data register) used for the PLC function consists of 16 bits.

Therefore, the value that can be stored in each register can be represented in the range from 0 to HFFFF in HEX.

3.9 Explanation of devices

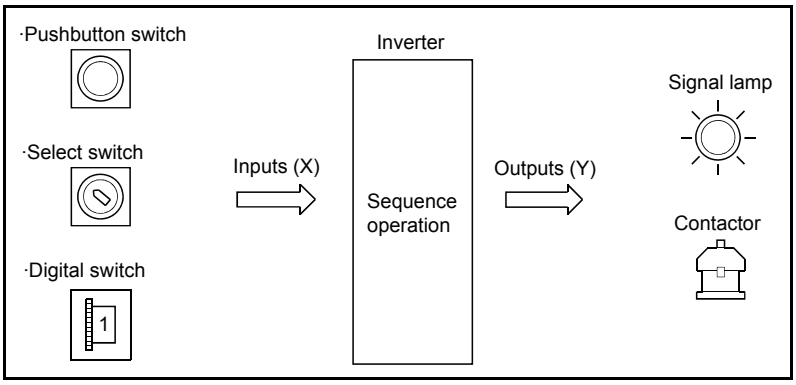
3.9.1 Device list

The following list shows device names and ranges that can be used for the PLC function.

Classification	Category	Device name	Number of points	Range of use	
Internal user device	Bit device	Input (X)	64 points	X0 to X3F <12 points installed>	HEX
		Output (Y)	64 points	Y0 to Y3F <12 points installed>	HEX
		Internal relay (M)	128 points	M0 to M127	DEC
		Latch relay (L)	-	- (Can be set with PLC function parameters but will not latch)	-
	•Bit device (contact/coil) •Word device (present value)	Timer (T)	16 points	T0 to T15 100 ms timer: 0.1 to 3276.7 s can be set 10 ms timer: 0.01 to 327.67 s can be set 100 ms retentive timer: 0.1 to 3276.7 s can be set	DEC
		Counter (C)	16 points	C0 to C15 Normal counter: Setting range 1 to 32767 Interrupt program counter: Not used	DEC
	Word device	Data register (D)	256 points	D0 to D255	DEC
Internal system device	Bit device	Special relay (SM)	2048 points	SM0 to SM2047 (with limited functions)	DEC
	Word device	Special register (SD)	2048 points	SD0 to SD2047 (with limited functions)	DEC

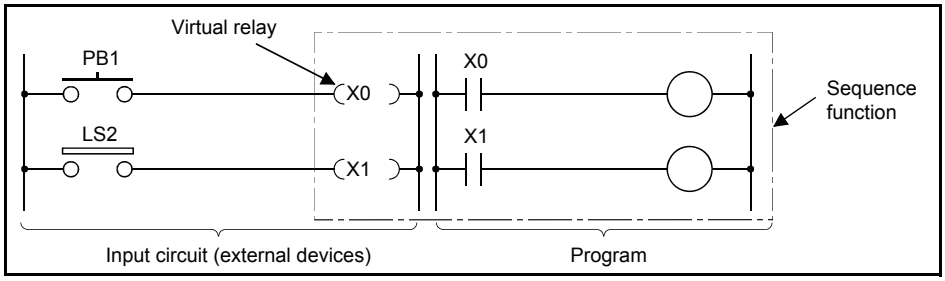
3.9.2 I/O X and Y

The input and output are devices that are used for communication between the inverter and external devices.
The input is given ON/OFF information externally to the control input terminals. Information is used as contacts (NO contact and NC contact) and source data of basic instructions in programs. On the other hand, the output is used to output program operation results from the control output terminals.

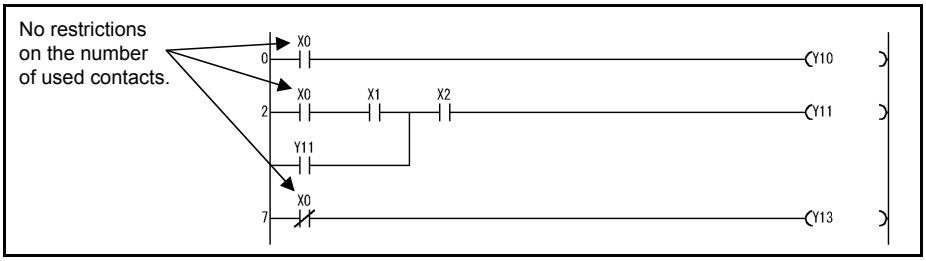


◆Input X

- The input allows external devices, such as push-button switches, selection switches, limit switches, and digital switches, to give commands and data to the inverter (PLC function).
- Assuming that the PLC function has internal virtual relays (Xn), the NO contacts and NC contacts of those Xn are used in programs.



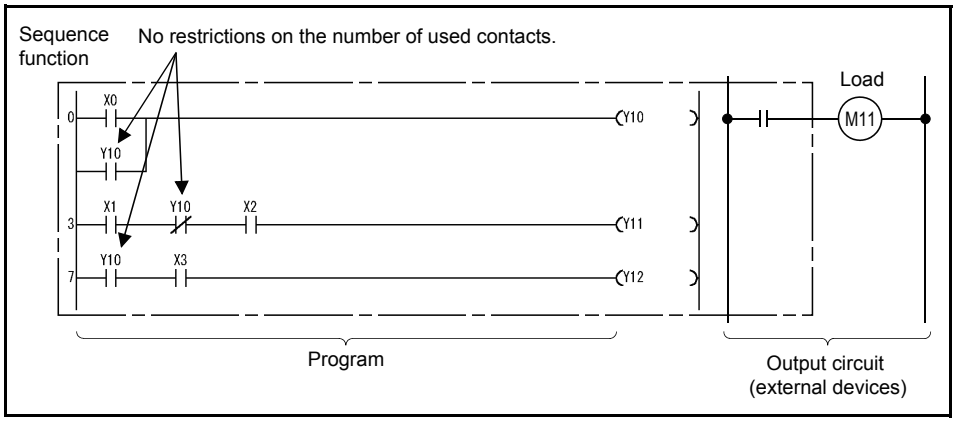
- There is no limit on the number of NO contacts and NC contacts of Xn used in a program.



When the inverter is used without connecting any external device to the control input terminal, "X" can be substituted for internal relay "M".

◆Output Y

- The output performs output of program control results to external devices (signal lights, digital Human Machine Interfaces (HMI), electromagnetic switches (such as contactors and solenoids)).
- Output information can be output through a single NO contact or an equivalent device.
- There is no limit on the number of NO contacts and NC contacts of output Yn used in a program as long as it is within the range of the program capacity.



When the inverter is used without connecting the control input terminals to external devices, "Y" can be substituted for internal relay "M".

3.9.3 Internal relay M

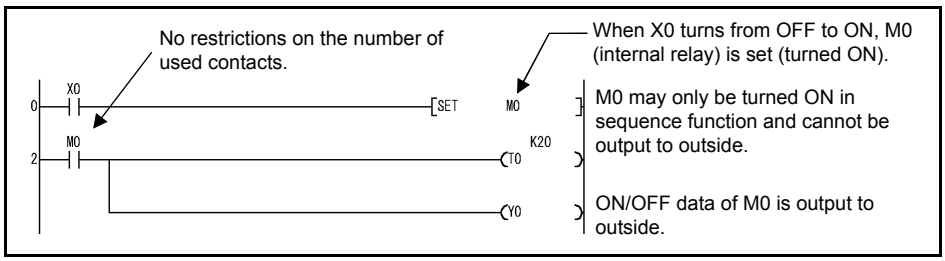
Internal relays are auxiliary relays that are used in the PLC function internally. These relays cannot latch (power failure retention).

Performing any of the following turns all internal relays OFF.

- When the power supply was turned ON
- When resetting

There is no limit on the number of contacts (NO contact and NC contact) to be used in a program.

Use the output (Y) to output sequence program operation results.


No restrictions on the number of used contacts.
When X0 turns from OFF to ON, M0 (internal relay) is set (turned ON).
X0
SET
M0
M0 may only be turned ON in sequence function and cannot be output to outside.
K20
T0
Y0
ON/OFF data of M0 is output to outside.

3.9.4 Timer T

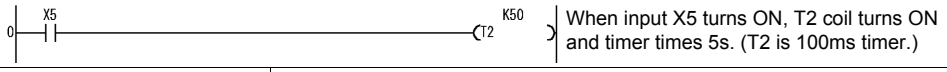
The PLC function uses up-timing timers.
The up-timing timer starts measuring a present value when the timer's coil turns ON, and then the timer's contact turns ON when the present value reaches a setting value.

3.9.5 100 ms timer, 10 ms timer, and 100 ms retentive timer

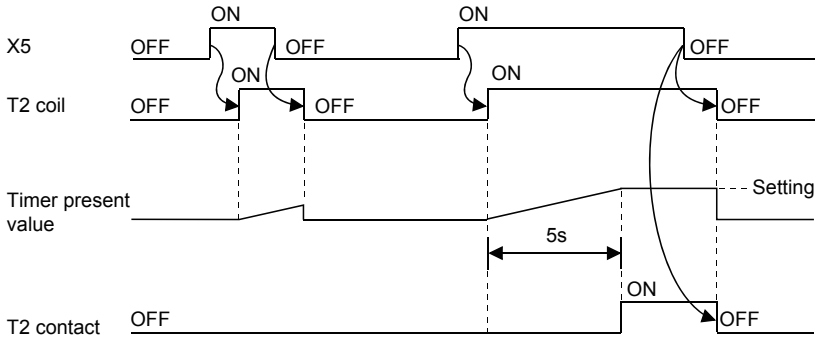
◆100 ms timer and 10 ms timer

The timer starts measuring a present value when the timer's coil turns on, and then the present value returns to 0 and the timer's contact turns OFF when the coil turns OFF.

Ladder example



Timing chart



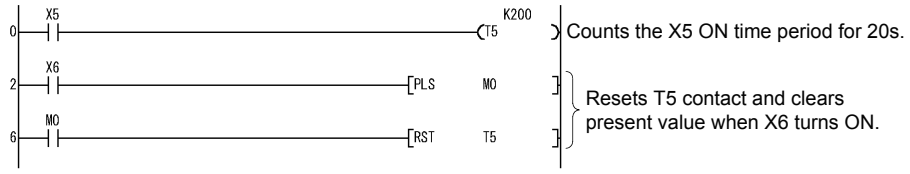
NOTE

- Changing between the 100 ms timer, 10 ms timer, and 100 ms retentive timer can be done using PLC function parameters. (The initial setting is the 100 ms timer.)

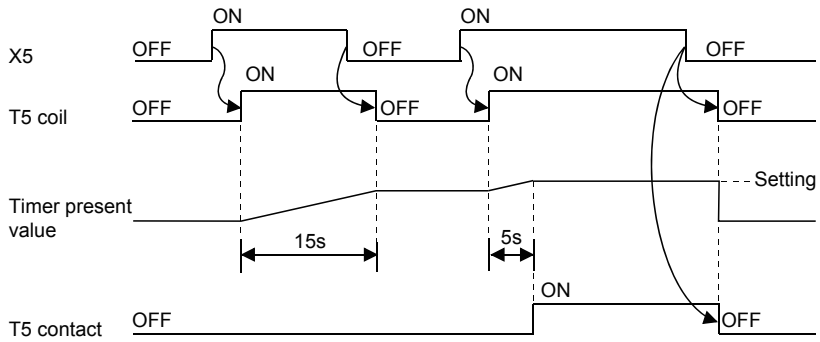
◆100 ms retentive timer

- The 100 ms retentive timer is a timer that measures the time period during which its coil is ON.
  It starts measuring a present value when its coil turns ON and retains the present value and its contact ON/OFF status even when the coil turns OFF.
  It resumes measurement from the retained present value when the coil turns ON again.
- Use the RST T□ instruction to clear the present value and turn OFF the contact.

Ladder example



Timing chart



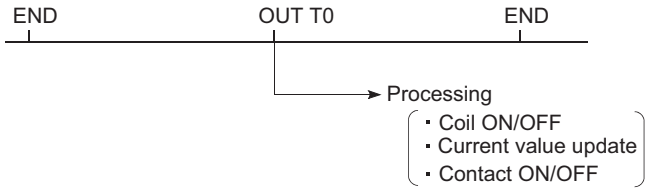
3.9.6 Processing and accuracy of timers

◆Processing

When the OUT T□ instruction is executed, the on/off switching of the timer coil, current value update, and on/off switching of the contact are performed. In the END processing, the current timer value is not updated and the contact is not turned on/off.

[Program example]

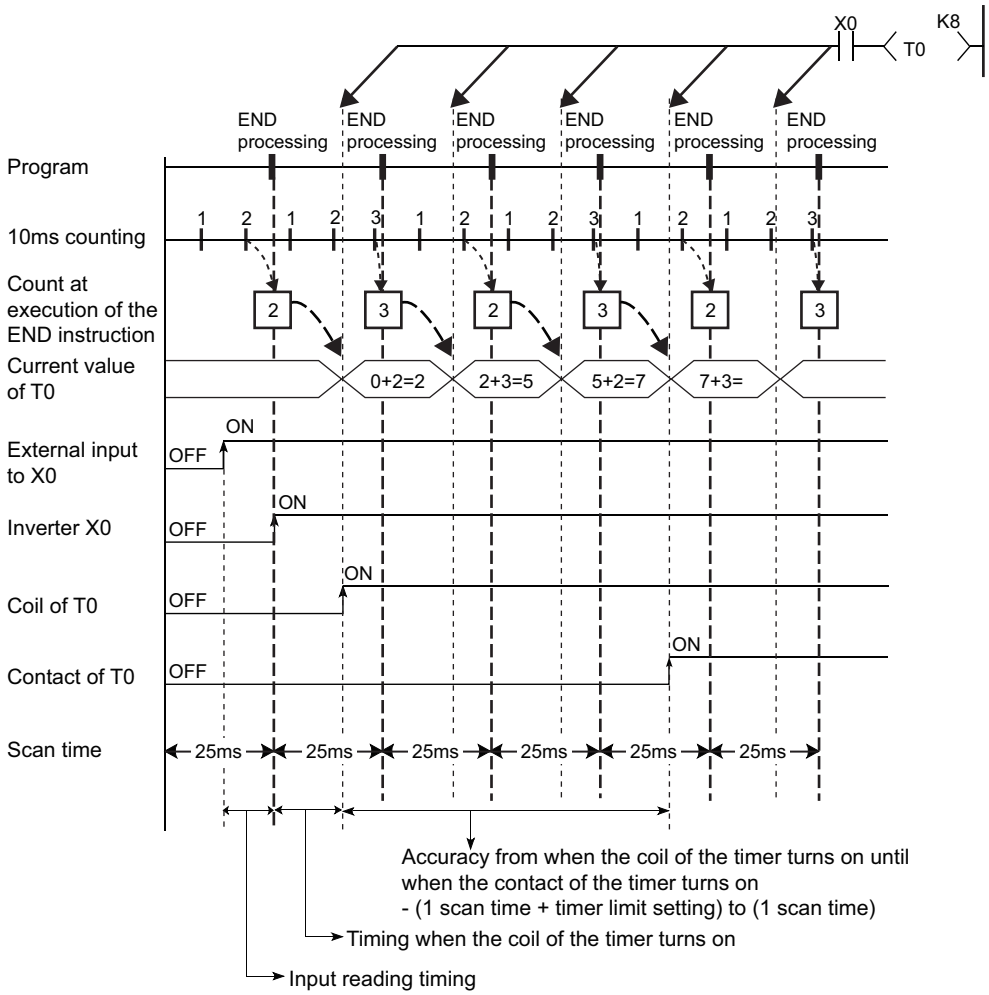
[Processing at execution of OUT T0 instruction]



◆Accuracy

The value obtained by the END instruction is added to the current value when the OUT T☐ instruction is executed. The current value is not updated while the timer coil is off even if the OUT T☐ instruction is executed.

Timer limit setting=10ms, Setting value of T0=8 (10ms×8=80ms), Scan time=25ms



Accuracy of the timer response that is from reading input (X) to output the data are up to "2-scan time + timer limit setting".

3.10 Counter C

The PLC function uses up-timing counters.
The up-timing counter turns its contact ON when the count value reaches a setting value.

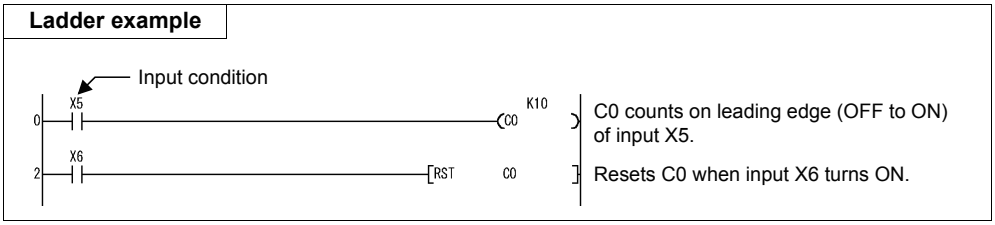
◆Count processing

- The counter's coil turns on/off at execution of the OUT C□ instruction, and then the counter's present value is updated and its contact turns ON after the END instruction is executed.
- The counter detects the coil's rise (OFF→ON) and then starts counting. Therefore, it will not start counting if the coil remains ON.

◆Counter reset

- The count value is not cleared even when the coil turns OFF. Use the RST C□ instruction to clear the count value and turn the contact OFF.
- If the counter is reset with the RST instruction, the counter's present value and contact are cleared at execution of the RST instruction.

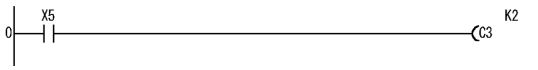
Ladder example



3.10.1 Count process in refresh mode

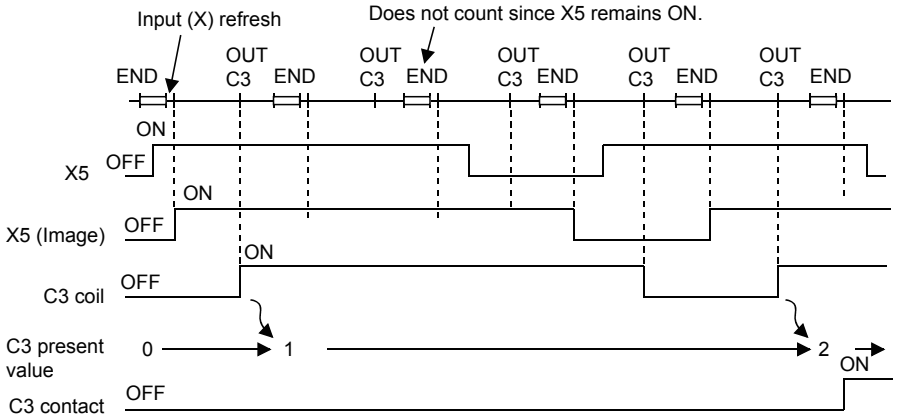
The counter counts at the rise of the counter's input conditions stored at input refresh.

Ladder example



When OFF to ON of X5 is counted twice, C3 contact turns ON.

Counting method



NOTE

- For the maximum counting speed of the counter, refer to **page 90**.

3.10.2 Maximum counting speed of counter

The maximum counting speed of the counter is determined by scan time, and counting is possible only when the ON/OFF time specified in the input conditions is longer than the scan time.

$$\text{Maximum counting speed Cmax} = \frac{n}{100} \times \frac{1}{ts} \text{ [times/s]}$$

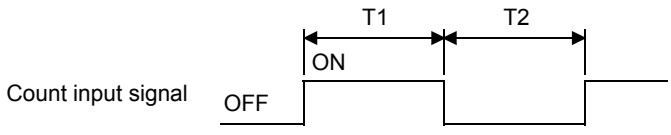
n : Duty (%)
ts : Scan time [s]

NOTE

- Duty n is a ratio between the ON and OFF time of count input signals and is represented as a percentage (%).

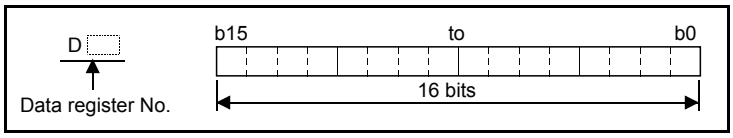
$$\text{When } T1 \leq T2 \quad n = \frac{T1}{T1 + T2} \times 100[\%]$$

$$\text{When } T1 > T2 \quad n = \frac{T2}{T1 + T2} \times 100[\%]$$



3.11 Data register D

- Data registers are memories that can store numerical data (from -32768 to 32767 or from H0000 to HFFFF) within the PLC function.
  Each data register consists of 16 bits; therefore, data can be read and written in 16-bit increments.



- Data stored during execution of a sequence program is retained until overwritten with new data.
- Unused timers (T) and counters (C) can be substituted for data registers if the number of data registers is insufficient.

3.12 Special relays and special registers

Special relays and special registers are internal relays and data registers, respectively, whose applications are already determined in the PLC function.
The following are the main applications of special relays and special registers.

◆Sequence operation check

The following special relays and special registers can be used for checking sequence program operations.

- Operating status (RUN/STOP) check
- Error detection through self-diagnostic function
- Operation error detection
- Scan time check

◆Timing contact

The following items are special relays with different operating statuses that can be used for sequence programs.

- Always ON/OFF flag
- RUN flag (OFF for one scan)
- Initial processing flag (ON for one scan)

NOTE

- For special relays and special registers that can be used in the PLC function, refer to page 17.

Item	Special relay number	Application/description
Diagnostic error	SM0	Turned ON when a diagnostic error has been detected. ON status is retained even after the condition becomes normal.
Self-diagnostic error	SM1	Turned ON when an error is detected by self-diagnosis. ON status is retained even after the condition becomes normal
Common error information	SM5	When SM5 is turned ON, common error information (SD5 to SD15) is stored.
Individual error information	SM16	When SM16 is turned ON, error individual information (SD16 to SD26) is stored.
Operation error flag	SM56	Turned ON when an operation error is detected during instruction execution. ON status is retained even after the condition becomes normal.
Clock data read request	SM213	Clock data is read in BCD value to SD210 to SD213 when this relay is turned ON. The process is not executed when the relay is OFF.
Always ON	SM400	SM400 and SM401 are respectively turned ON and OFF regardless of the STOP and RUN states.
Always OFF	SM401	
ON only for one scan after RUN	SM402	SM402 and SM403 change depending on the STOP and RUN states. In the cases other than STOP: SM402 is ON only for one scan. SM403 is OFF only for one scan.
OFF only for one scan after RUN	SM403	

3.13 Function list

Function	Description
Remote RUN/STOP	This function executes remote RUN/STOP from an external source when the SQ signal is ON (PLC function RUN state (P.RUN is ON)).
Watchdog timer variable (10 to 2000 ms)	This is a PLC function internal timer for detecting errors in the hardware or programs. Its setting value can be changed.
Self-diagnostic function	This function diagnoses the presence of an error within the PLC function itself, and performs error detection, display and stoppage of the PLC function.
Output settings for STOP→RUN	The output (Y) status when the state changes from the STOP state to the RUN state.
Keyword registration	This setting prevents reading/writing of programs (parameter and main/sub programs) and comments.

NOTE

- The following functions cannot be used.
  Constant scan, latch (retention at power failure), PAUSE, status latch, sampling trace, step operation, clock, interrupt processing, comment, microcomputer mode, print title entry, annunciator display mode, ERROR LED priority settings.

3.14 RUN/STOP method of PLC function from an external source (remote RUN/STOP)

The PLC function RUN/STOP is executed by ON/OFF of the SQ signal.
Remote RUN/STOP is performed by RUN/STOP of the PLC function from an external source when the SQ signal remains in the ON state (RUN state).

◆Application of remote RUN/STOP

Remote RUN/STOP can be performed by remote control using remote RUN/STOP in the following types of cases.

- When the inverter is out of reach
- When executing RUN/STOP for the inverter in an enclosure from an external source

◆Operation at remote RUN/STOP

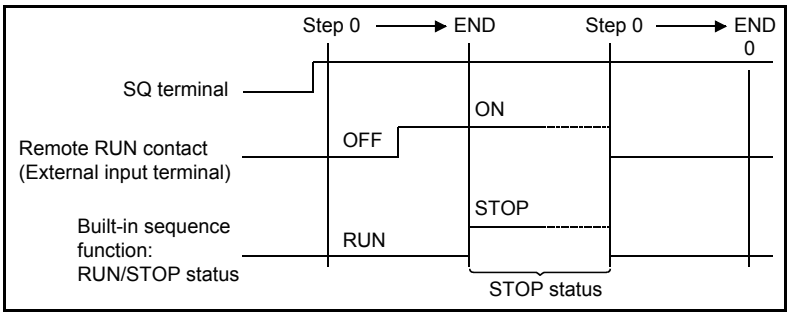
The operations of the sequence program that performs remote RUN/STOP are as follows.

- Remote STOP:
  The sequence program is executed up to the END instruction, and enters the STOP state.
- Remote RUN:
  If remote RUN is executed when the inverter has been switched to the "STOP state" by remote STOP, the state changes to RUN state again, and the sequence program is executed from step 0.

◆Remote RUN/STOP method

The following methods can be used for remote RUN/STOP.

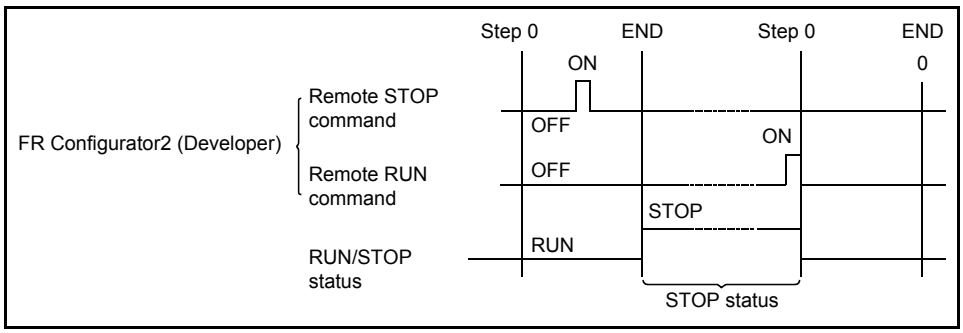
- Setting using the PLC function parameters (by contact)
  Remote RUN/STOP can be executed by turning the remote RUN contact OFF/ON.
  For example, this can be used to STOP the PLC function at the emergency stop contact.
  (The state is "RUN" when the remote RUN contact is OFF, and "STOP" when the remote RUN contact is ON.)



POINT

- PLC function parameter settings for the remote RUN contact
  X0 to X1F can be set for the remote RUN contact.
  (For details, refer to the Instruction Manual of FR Configurator2)

- Using FR Configurator2 (Developer)
  RUN/STOP can be performed by operating remote RUN/STOP from FR Configurator2 (Developer).
  For example, this can be used to STOP the inverter in order to rewrite the sequence program when it is installed in an out of reach location.



◆Note

Note the following points because the PLC function has priority on STOP.

- The PLC function switches to the STOP state when remote STOP is executed from any source such as the remote RUN contact or FR Configurator2 (Developer), etc.
- After switching the PLC function to the STOP state with remote STOP, all external factors (remote RUN contact, FR Configurator2 (Developer), etc.) that executed the remote STOP must be RUN in order to switch the PLC function back to the RUN state.

NOTE

- In the RUN state, the sequence program step 0 to the END instruction are executed repeatedly.
  In the STOP state, all sequence program operations are stopped, and all outputs (Y) are OFF.

3.15 Watchdog timer (watchdog error supervision timer)

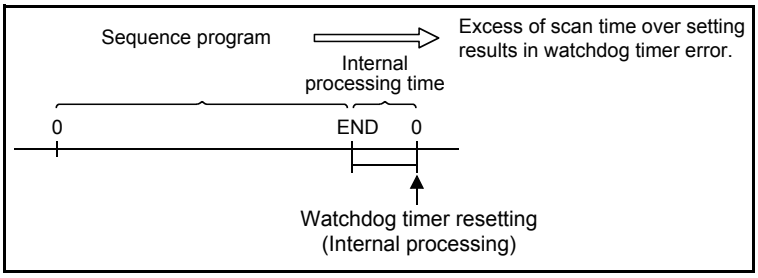
◆Watchdog timer

The watchdog timer is a PLC function internal timer for detecting errors in the hardware or sequence program. Use FR Configurator2 (Developer). Select the [PC parameter] window, [PC RAS setting] tab, and set the watchdog timer.

PLC function parameter	Name	Initial value	Setting range	Minimum setting increments
PLC RAS setting	WDT (Watchdog timer) setting	200 ms	10 to 2000 ms	10 ms

◆Watchdog timer reset

The PLC function resets the watchdog timer before step 0 is executed (after the END processing is executed).
When the PLC function operates normally and the END instruction is executed by the sequence program within the setting value, the watchdog timer does not output the signal.
When a PLC function hardware failure occurs or if the END instruction of the scan time could not be executed well within the setting value, the watchdog timer outputs the signal.



◆Process when the watchdog timer reaches the setting value

If the scan time exceeds the setting value of the watchdog timer, a watchdog timer error occurs and the PLC function is as follows.

- All outputs of the PLC function turn OFF.
- The P.RUN LED blinks.
- SM1 turns on, and an error code is stored in SD0. (Refer to page 33.)

3.16 Self-diagnostic function

The self-diagnostic function diagnoses the presence of an error within the PLC function itself.

◆Self-diagnostic timing

The self-diagnostic is executed at power-on, at reset, when each instruction is executed and when the END instruction is executed.

- At power-on, at reset.
  Diagnoses whether the operation can be executed.
- When each instruction is executed
  An error occurs if the operation of each instruction of the sequence program could not be executed.
- When the END instruction is executed
  Watchdog error supervision is performed.

◆Operation mode when an error is detected

There are two types of PLC function operations for when an error is detected by self-diagnosis; the operation stops or operation continues.
Even if the operation is set to continue, some errors can cause operation stop with the PLC function settings. (Refer to page 97.)

- If an operation-stop error is detected by the self diagnosis, the operation is stopped as soon as the error is detected, and all the outputs (Y) turn OFF.
- If an operation-continued error is detected, the faulty program area is skipped, and the operation continues from the next step.

◆Confirmation of fault record

When an operation error occurs, SM0 (self-diagnosis error) turns ON and an error code is stored in SD0 (self-diagnosis error). Particularly when the operation is set to be continued, use in the program and to prevent a malfunction in the machine system.
For details on the fault record detected by self-diagnosis, refer to the error code list on page 198.

3.16.1 Operation mode when there is an operation error

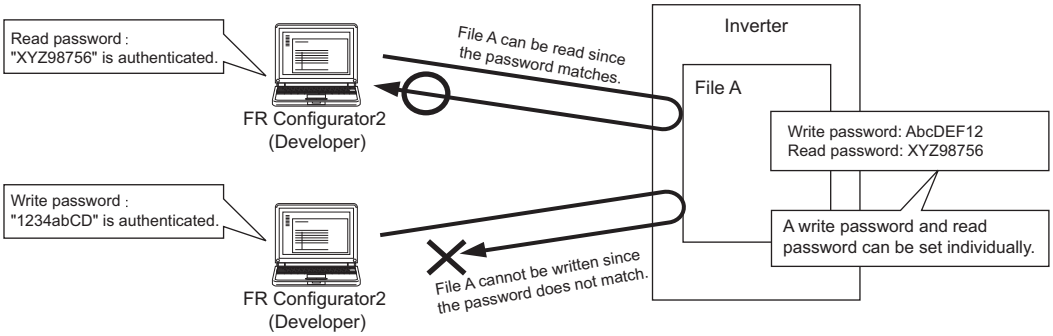
The PLC function can be set to either stop or continue operation of the sequence program when an operation error occurs. The setting of whether to stop or continue operation is set in the PLC function parameters.

- The initial status of the operation mode and PLC function status when there is an operation error are as shown in the following table.

Error definition		PLC function status				P.RUN LED
		Operation Initial status	Special relay turned ON	Special register for data storage	Self-diagnostic error number (SD0)	
Operation error	An error such as an attempting BCD conversion on a value that exceeds 0 to 9999 (or 0 to 99999999) occurred in the sequence program.	Continue	SM0	SD0	50	ON

3.17 Registering file password

This function sets write password and read password for each file stored in the inverter so that files are protected against tampering and theft by unauthorized persons. To set up a file password, select [Online] of FR Configurator2 (Developer), [Password/key word], and then [Registration/change].



◆File protection timing

File protection is enabled immediately after the passwords are registered, and it is disabled immediately after the passwords are deleted.

◆Password target files

A password can be set to the following files.

- Program
- Device comment
- Initial device value
- Parameter
- Source information

◆Operations that are controlled and the number of characters

A password can be set to the following operations. A password can be 4 to 32 alphanumeric characters (capital or lowercase letters).

- Reading files
- Writing files
- Reading/writing files

◆Online operations that require password authentication

Authentication is required to execute the following operations to password-protected files.

- Write to PLC (data writing)
- Read from PLC (data reading)
- Online change (data writing)
- Change TC setting value (data writing)
- Verify with PLC (data reading)
- Create/Change or Delete of a password (data reading and writing)
- Delete PLC data (data writing)

NOTE

- For the procedure and precaution on the password change, cancellation, and unlock, refer to the GX Works2 Version1 Operating Manual (Common).
- Even when the password function **(Pr.296, Pr.297)** is enabled, FR Configurator2 can be used to read/write the inverter parameter settings. To use the password function and PLC function at the same time, register keywords and lock reading/writing of the ladder program.
- The purpose of the file password is different from that of the inverter password function **(Pr.296, Pr.297)**.
- If the password has been forgotten, clear the flash memory. However, doing so will also clear the PLC function programs and the parameters for the PLC function. (Refer to page 50)

3.18 Output (Y) status settings when STOP status → RUN status

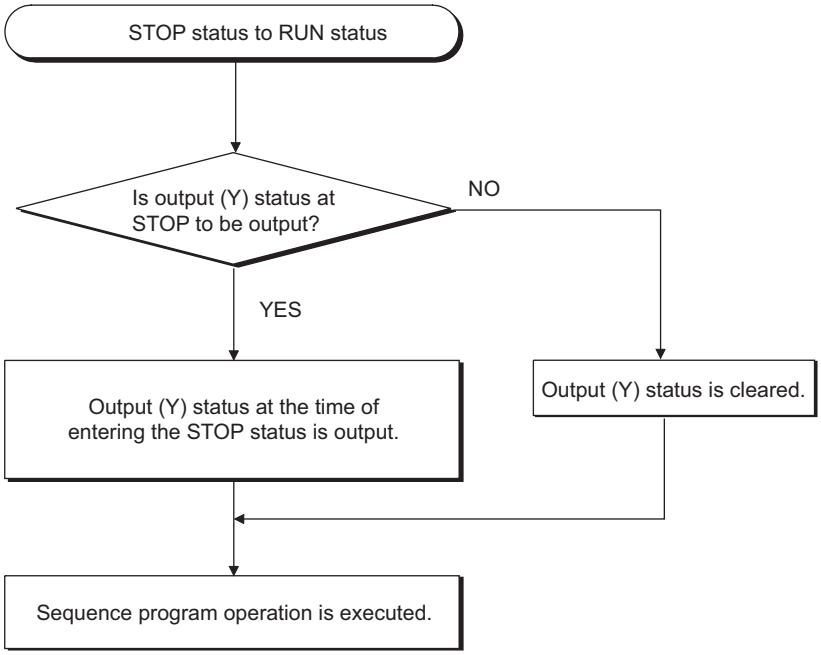
When changing from a state such as the RUN state to the STOP state, the RUN state output (Y) is stored in the PLC function. When changing from the STOP state to the RUN state, the PLC function parameter settings can be configured to either re-output the output (Y) or to output after operation execution.

"Output the output (Y) status before STOP"

After outputting the output (Y) status directly before the STOP state, the sequence program operation is executed.

"Clear the output (Y) (output after 1 scan)"

After clearing all outputs (Y) and executing the sequence program operation, the output (Y) is output.


STOP status to RUN status
Is output (Y) status at STOP to be output?
NO
YES
Output (Y) status at the time of entering the STOP status is output.
Output (Y) status is cleared.
Sequence program operation is executed.

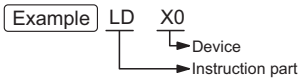
3.19 Structure of instructions

Most of the instructions can be divided between the instruction section and device, and the applications are as follows.

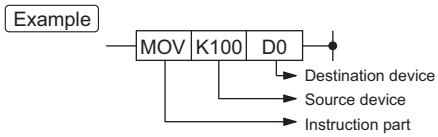
- Instruction section
  Indicates the functions of the instruction.
- Device
  Indicates the data used by the instruction.

The structure of instructions based on a combination of the instruction section and device can be broadly divided into the following categories.

- Instruction section
  Instructions that do not change the device status, and mainly perform program controls.
  Example END
- Instruction section + Device
  Controls device ON/OFF, controls the execution condition according to the device ON/OFF status, and performs program branching, etc.



- Instruction section + Source device + Destination device
  Performs operation on the destination data and source data, and stores the operation result in the destination.



- Others
  Combinations other than those above.

◆Source (S)

A source is the data used in the operation.
It is as shown below depending on the specified device.

- Constant
  Specifies the value used in the operation. It is a fixed value that cannot be changed when the program is being executed because it is set when the program is created.
- Bit device, word device
  Specifies the device in which the data used in the operation is stored. Therefore, the data needs to be stored in the specified device before the operation is executed. The data used in the instruction can be changed by changing the data stored in the specified device while the program is being executed.

◆Destination (D)

The data after operation is stored in the destination.

However, when instructions are constructed of a combination of Instruction section + Source device + Destination device, the data to be used in the operation needs to be stored in the destination before the operation.
The device in which data is to be stored must be specified in the destination.

NOTE

- In this manual, the source and destination shall be indicated as the following abbreviations.
  Source: (S), Source 1: (S1), Source 2: (S2), Destination: (D), Destination 1: (D1)

3.20 Bit device processing method

Processing methods available for when a bit device (X, Y, M) is specified are 1-bit processing, and 16-bit and 32-bit processing which are accompanied by digit specification.

3.20.1 1-bit processing

When sequence instructions are used, the device that is the operation processing target is 1 bit (1 point) of the bit device, and multiple bits cannot be specified.

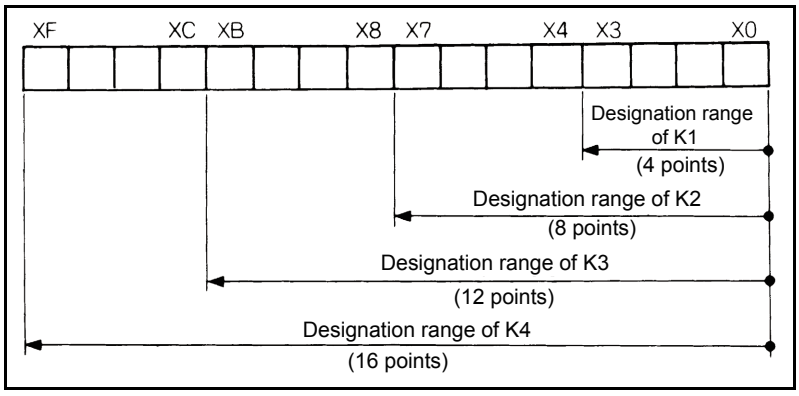
Example LD X0, OUT Y20

3.20.2 Digit specification processing

When basic instructions or application instructions are used, there are situations in which the bit device that is the operation processing target needs to be specified with digit specification. When the processing increment of this digit specification is a 16-bit instruction, up to 16 points can be specified in 4-point increments.

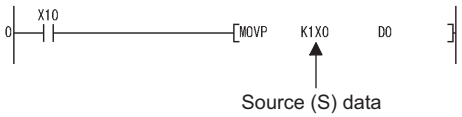
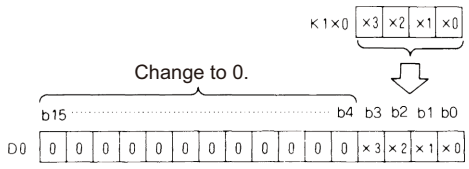
◆16-bit instruction: K1 to 4 (4 to 16 points)

Example Setting range from 16-bit data digit specification of X0 to F

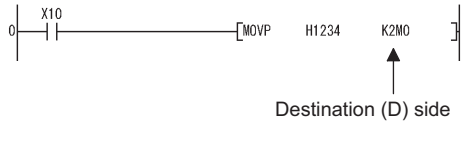
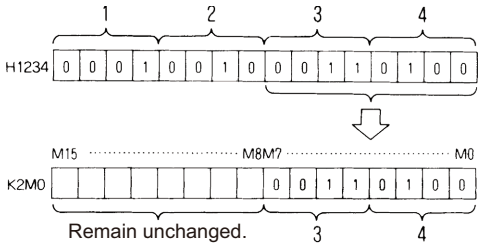
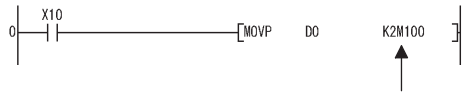
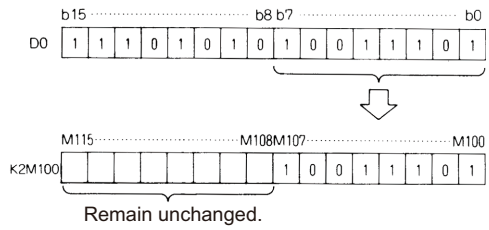


- When there is a digit specification on the source (S) side, the values that can be handled as source data are indicated in the table below.

Specified number of digits	16-bit instruction
K1 (4-point)	0 to 15
K2 (8-point)	0 to 255
K3 (12-point)	0 to 4095
K4 (16-point)	-32768 to 32767

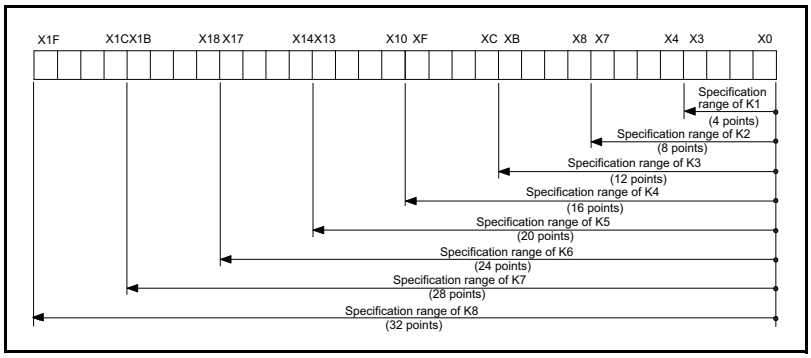
Ladder example	Process
16-bit instruction  	

- When there is a digit specification on the destination (D) side, the number of points from the digit specification is applied to the destination side.

Ladder example	Process
When source (S) data is values 	
When source (S) data is a word device 	

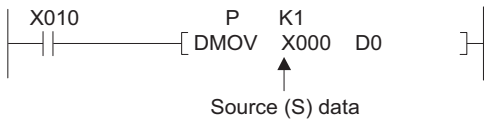
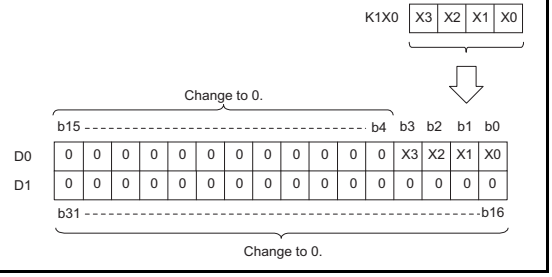
◆32-bit instruction: K1 to 8 (4 to 32 points)

Example Setting range X0 to 1F by 32-bit data digit specification

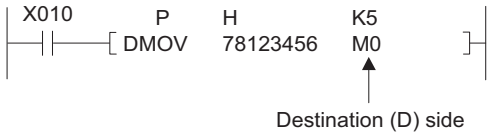
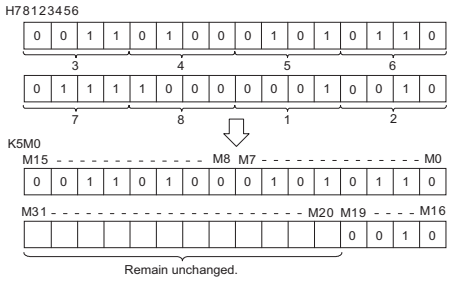
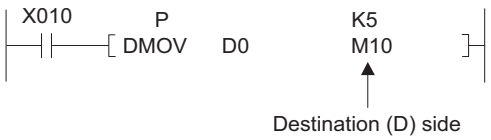
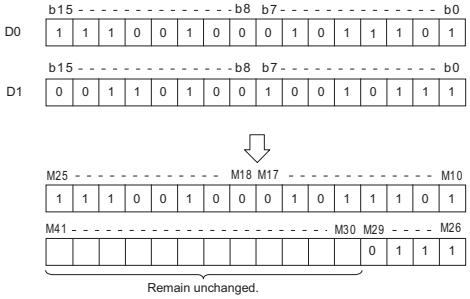

X1F X1CX1B X18X17 X14X13 X10 XF XC XB X8 X7 X4 X3 X0
Specification range of K1 (4 points)
Specification range of K2 (8 points)
Specification range of K3 (12 points)
Specification range of K4 (16 points)
Specification range of K5 (20 points)
Specification range of K6 (24 points)
Specification range of K7 (28 points)
Specification range of K8 (32 points)

- When there is a digit specification on the source (S) side, the values that can be handled as source data are indicated in the table below.

Specified number of digits	32-bit instruction	Specified number of digits	32-bit instruction
K1 (4-point)	0 to 15	K5 (20-point)	0 to 1048575
K2 (8-point)	0 to 255	K6 (24-point)	0 to 16777215
K3 (12-point)	0 to 4095	K7 (28-point)	0 to 268435455
K4 (16-point)	0 to 65535	K8 (32-point)	-2147483648 to 2147483647

Ladder example	Process
32-bit instruction 	

- When there is a digit specification on the destination (D) side, the number of points from the digit specification is applied to the destination side.

Ladder example	Process
When source (S) data is values 	
When source (S) data is a word device 	

NOTE

- When 32-bit data is stored in word devices, it is stored in two consecutive word devices. An error does not occur even if the stored data exceeds the range of the corresponding device, but the content of devices outside of the range is changed. When storing data, check beforehand that the amount of devices required for storage can be allocated.

3.21 Handling of numerical values

The PLC function has an instruction for handling values indicated in 16 bits and 32 bits.
The most significant bit of the 16 bits and 32 bits is used to judge positive or negative. Therefore, the values that can be handled are as follows.
16-bit: -32768 to 32767
32-bit: -2147483648 to 2147483647

POINT

- Value setting method

1) Decimal

10 is stored into D10 in BIN.

-10 is stored into D10 in BIN.

2) Hexadecimal

10 is stored into D10 in hexadecimal.

Decimal and hexadecimal displays are supported as shown below.

• 16 bits

Decimal display	Hexadecimal display
32767	H7FFF
to	to
5	H0005
4	H0004
3	H0003
2	H0002
1	H0001
0	H0000
-1	HFFFF
-2	HFFFE
-3	HFFFD
-4	HFFFC
-5	HFFFB
to	to
-32768	H8000

• 32 bits

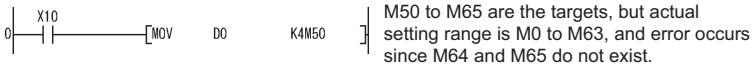
Decimal display	Hexadecimal display
2147483647	H7FFFFFFF
to	to
5	H00000005
4	H00000004
3	H00000003
2	H00000002
1	H00000001
0	H00000000
-1	HFFFFFFFF
-2	HFFFFFFFE
-3	HFFFFFFFD
-4	HFFFFFFFC
-5	HFFFFFFFB
to	to
-2147483648	H80000000

3.22 Operation error

An operation error occurs in the basic instruction in the following cases.
When an error listed in the description of each instruction occurs.

POINT

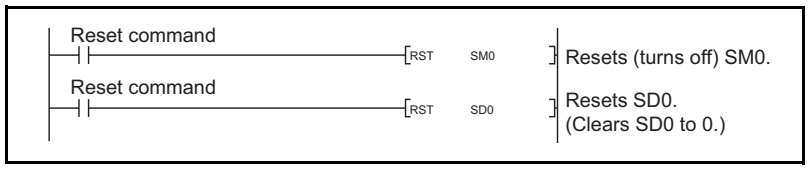
- Note that an operation error does not occur when the device specified range exceeds the corresponding device range, and data is written to devices other than the specified device.


X10
0
MOV
D0
K4M50
M50 to M65 are the targets, but actual setting range is M0 to M63, and error occurs since M64 and M65 do not exist.

◆Error processing

If an operation error occurs when a basic instruction is executed, SM0 turns ON and an error code is stored in SD0. (SM0 remains ON even if subsequent processing is normal.)

- The error code of the instruction in which the operation error occurred when SM0 changed from OFF to ON is stored in SD0. Therefore, the content of SD0 does not change when SM0 remains ON.
- The following type of program resets SD0 and SM0.



- When an operation error occurs, the choice of whether to stop or continue sequence processing can be made in the PLC function parameter settings. For details, refer to page 97.

3.23 Sequence instructions list

3.23.1 How to view the instruction list table

Classification	Instruction symbol	Symbol	Process description	Execution condition	Number of steps
Transfer	MOV	MOV S D	(S)→(D)		5
	MOVP	MOVP S D			
↑ 1)	↑ 2)	↑ 3)	↑ 4)	↑ 5)	↑ 6)

1): Instructions are classified according to application.

2): Indicates the instruction symbol used in the program.

Instruction symbols are based on 16-bit instructions.

- Change the instruction symbols for 32-bit instructions as shown below.
  32-bit instructions: Add a D to the start of the instruction.

Example + → D+

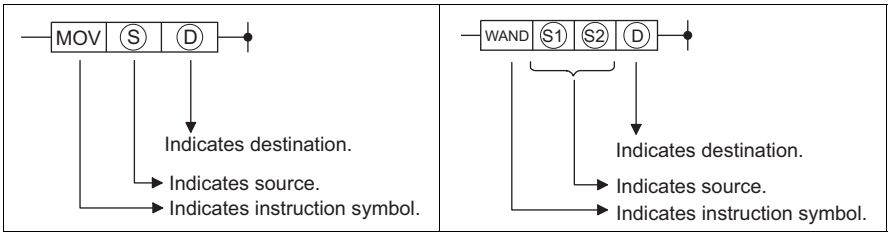
16-bit command 32-bit command

- Change the instruction symbol so that the start execution command is output when the signal is ON, as shown below.
  Add a P to the end of the instruction that is executed only at the leading edge of OFF to ON.

Example MOV ➡ MOVP

Instruction executed during ON Instruction executed only at the leading edge of OFF to ON

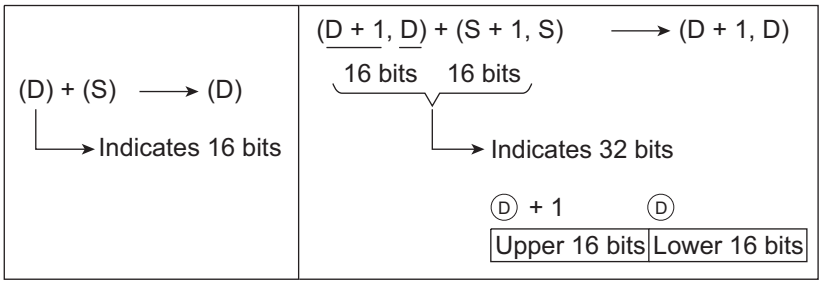
3): Indicates the symbol diagram on the ladder.



Destination: Indicates the destination of the data after operation.

Source: Stores the data before operation.

4): Indicates the process description of each instruction.

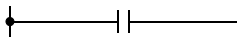
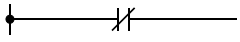
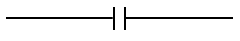
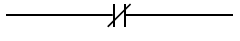
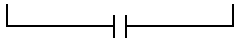
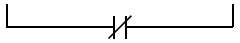
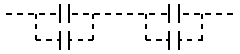
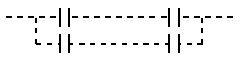
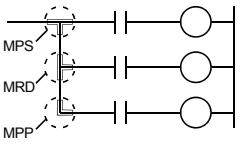
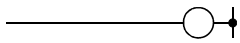
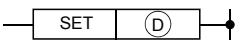
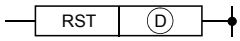
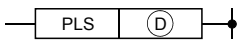
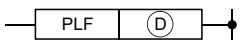
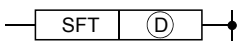
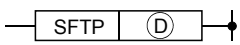
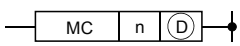
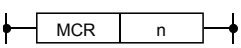
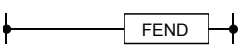
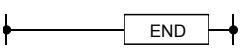


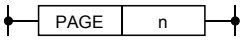
5): Details of the execution conditions for each instruction are as follows.

Symbol	Execution condition
Blank	An always executed instruction. It is always executed irrespective of whether the instruction prior condition is ON/OFF. When the prior condition is OFF, the instruction executes the OFF process.
	The instruction is executed only while the prior condition of the instruction is ON. When the prior condition is OFF, the instruction is not executed and is not processed.
	The instruction is executed one time only at the leading edge of the prior condition (OFF to ON), and is not executed or processed even when any subsequent conditions are ON.
	The instruction is executed only while the prior condition of the instruction is OFF. When the prior condition is ON, the instruction is not executed and is not processed.
	The instruction is executed one time only at the trailing edge of the prior condition (ON to OFF), and is not executed or processed even when any subsequent conditions are OFF.

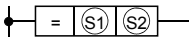
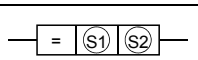
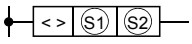
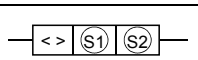
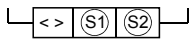
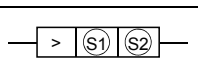
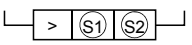
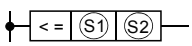
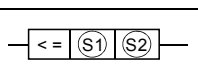
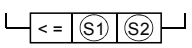
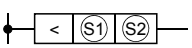
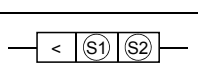
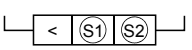
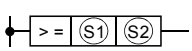
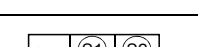
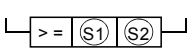
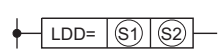
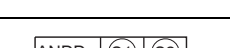
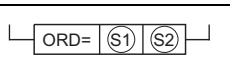
6): Indicates the number of program steps required for each instruction.

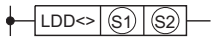
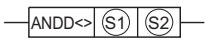
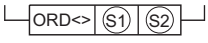
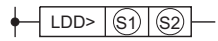
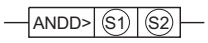
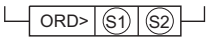
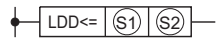
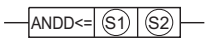
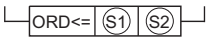
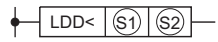
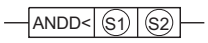
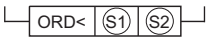
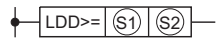
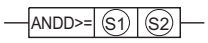
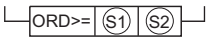
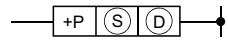
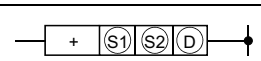
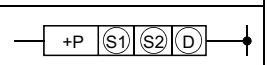
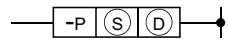
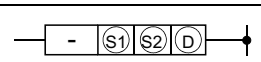
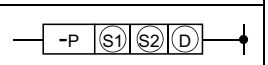
3.23.2 Sequence instructions list

Classification	Instruction symbol	Symbol	Process description	Execution Condition	Refer to page
Contact	LD		Logical operation start (NO contact operation start)		117
	LDI		Logical NOT operation start (NC contact operation start)		
	AND		Logical AND (NO contact series connection)		
	ANI		Logical AND NOT (NC contact series connection)		
	OR		Logical OR (NO contact parallel connection)		
	ORI		Logical OR NOT (NC contact parallel connection)		
Link	ANB		AND between logical blocks (Series connection between blocks)		119
	ORB		OR between logical blocks (Parallel connection between blocks)		
	MPS		Stores operation results		121
	MRD		Reads operation results stored in MPS		
	MPP		Reads and resets operation results stored in MPS		
Output	OUT		Device output		124
	SET		Device set		126
	RST		Device reset		
	PLS		Pulses of 1 program cycle are generated at the leading edge of input signal		128
	PLF		Pulses of 1 program cycle are generated at the trailing edge of input signal		
Shift	SFT		Device 1-bit shift		130
	SFTP				
Master control	MC		Master control start		132
	MCR		Master control release		
Program end	FEND		Termination of main program		135
	END		Always placed at the end of a sequence program to return to step 0.		135

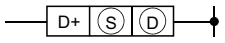
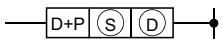
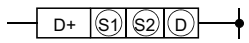
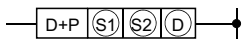
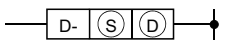
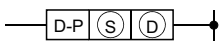
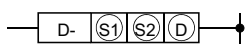
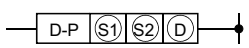
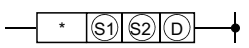
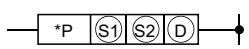
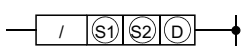
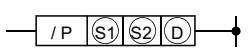
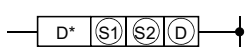
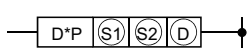
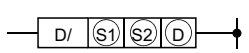
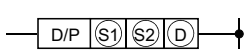
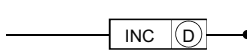
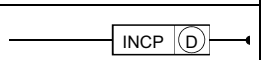
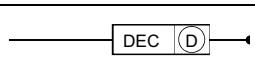
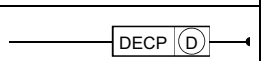
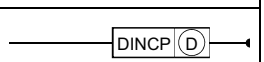
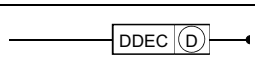
Classification	Instruction symbol	Symbol	Process description	Execution Condition	Refer to page
Non-processing	NOP	-	Non-processing. For program erasure or spacing.		136
	NOPLF		Non-processing. New line instruction for printer output.		
	PAGE		Ignored (Subsequent programs will be controlled from step 0 of page n)		

3.23.3 Basic instructions

Classification	Instruction symbol	Symbol	Process description	Execution condition	Refer to page
16-bit data comparison	LD=		When (S1) = (S2), conductive. When (S1) ≠ (S2), non-conductive.		140
	AND=				
	OR=				
	LD<>		When (S1) ≠ (S2), conductive. When (S1) = (S2), non-conductive.		
	AND<>				
	OR<>				
	LD>		When (S1) > (S2), conductive. When (S1) ≤ (S2), non-conductive.		
	AND>				
	OR>				
	LD<=		When (S1) ≤ (S2), conductive. When (S1) > (S2), non-conductive.		
	AND<=				
	OR<=				
	LD<		When (S1) < (S2), conductive. When (S1) ≥ (S2), non-conductive.		
	AND<				
	OR<				
	LD>=		When (S1) ≥ (S2), conductive. When (S1) < (S2), non-conductive.		
	AND>=				
	OR>=				
32-bit data comparison	LDD=		When (S1+1, S1) = (S2+1, S2), conductive. When (S1+1, S1) ≠ (S2+1, S2), non-conductive.		156
	ANDD=				
	ORD=				

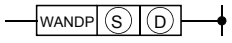
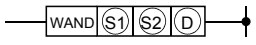
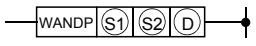
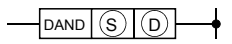
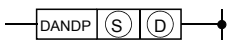
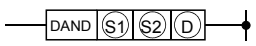
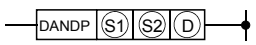
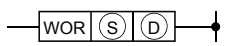
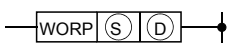
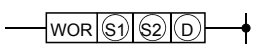
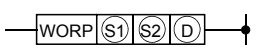
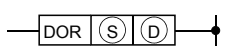
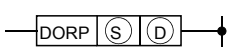
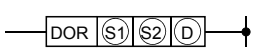
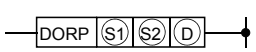
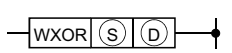
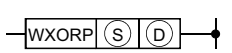
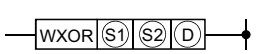
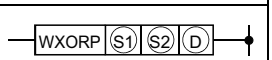
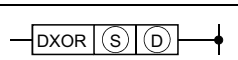
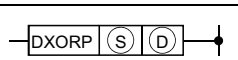
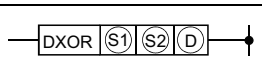
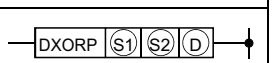
Classification	Instruction symbol	Symbol	Process description	Execution condition	Refer to page
32-bit data comparison	LDD<>		When (S1+1, S1) ≠ (S2+1, S2), conductive. When (S1+1, S1) = (S2+1, S2), non-conductive.		156
	ANDD<>				
	ORD<>				
	LDD>		When (S1+1, S1) > (S2+1, S2), conductive. When (S1+1, S1) ≤ (S2+1, S2), non-conductive.		
	ANDD>				
	ORD>				
	LDD<=		When (S1+1, S1) ≤ (S2+1, S2), conductive. When (S1+1, S1) > (S2+1, S2), non-conductive.		
	ANDD<=				
	ORD<=				
	LDD<		When (S1+1, S1) < (S2+1, S2), conductive. When (S1+1, S1) ≥ (S2+1, S2), non-conductive.		
	ANDD<				
	ORD<				
	LDD>=		When (S1+1, S1) ≥ (S2+1, S2), conductive. When (S1+1, S1) < (S2+1, S2), non-conductive.		
	ANDD>=				
	ORD>=				
BIN 16-bit addition/ subtraction	+		(S) + (D)→(D)		143
	+P				
	+		(S1) + (S2)→(D)		
	+P				
	-		(S) - (D)→(D)		
	-P				
	-		(S1) - (S2)→(D)		
	-P				

Sequence instructions list

Classification	Instruction symbol	Symbol	Process description	Execution condition	Refer to page
BIN 32-bit addition/ subtraction	D+		(D+1, D) + (S+1, S) →(D+1, D)		158
	D+P				
	D+		(S1+1, S1) + (S2+1, S2) →(D+1, D)		
	D+P				
	D-		(D+1, D) - (S+1, S) →(D+1, D)		
	D-P				
	D-		(S1+1, S1) - (S2+1, S2) →(D+1, D)		
	D-P				
BIN 16-bit multiplication/ division	*		(S1) × (S2)→(D+1, D)		146
	*P				
	/		(S1)/(S2)→quotient(D), remainder (D+1)		
	/P				
BIN 32-bit multiplication/ division	D*		(S1+1, S1) × (S2+1, S2) →(D+3, D+2, D+1, D)		161
	D*P				
	D/		(S1+1, S1)/(S2+1, S2) →quotient (D+1, D), remainder (D+3, D+2)		
	D/P				
BIN 16-bit data increment/ decrement	INC		(D)+1→(D)		149
	INCP				
	DEC		(D) - 1→(D)		
	DECP				
BIN 32-bit data increment/ decrement	DINC		(D+1, D)+1→(D+1, D)		164
	DINCP				
	DDEC		(D+1, D) - 1→(D+1, D)		
	DDECP				

Classification	Instruction symbol	Symbol	Process description	Execution condition	Refer to page
16-bit transfer	MOV	MOV (S) (D)	(S)→(D)		150
	MOVP	MOVP (S) (D)			
32-bit transfer	DMOV	DMOV (S) (D)	(S+1, S)→(D+1, D)		165
	DMOVP	DMOVP (S) (D)			
BIN 16-bit 2's complement	NEG	NEG (D)	0 - (D)→(D)		151
	NEGP	NEGP (D)			
BIN 32-bit 2's complement	DNEG	DNEG (D)	0 - (D+1, D)→(D+1, D)		167
	DNEGP	DNEGP (D)			
BIN 16-bit BCD conversions	BCD	BCD (S) (D)	BCD conversions (S) → (D); BIN (0 to 9999)		153
	BCDP	BCDP (S) (D)			
BIN 32-bit BCD conversions	DBCD	DBCD (S) (D)	BCD conversions (S+1, S) → (D+1, D); BIN (0 to 99999999)		168
	DBCDP	DBCDP (S) (D)			
BIN 16-bit BIN conversions	BIN	BIN (S) (D)	BIN conversions (S) → (D); BCD (0 to 9999)		154
	BINP	BINP (S) (D)			
BIN 32-bit BIN conversions	DBIN	DBIN (S) (D)	BIN conversions (S+1, S) → (D+1, D); BCD (0 to 99999999)		169
	DBINP	DBINP (S) (D)			

3.23.4 Application instructions

Classification	Instruction symbol	Symbol	Process description	Execution condition	Refer to page
BIN 16-bit logical AND	WAND		(D) AND (S)→(D)		171
	WANDP				
	WAND		(S1) AND (S2)→(D)		
	WANDP				
BIN 32-bit logical AND	DAND		(D+1, D) AND (S+1, S)→(D+1, D)		181
	DANDP				
	DAND		(S1+1, S1) AND (S2+1, S2) →(D+1, D)		
	DANDP				
BIN 16-bit logical OR	WOR		(D) OR (S)→(D)		174
	WORP				
	WOR		(S1) OR (S2)→(D)		
	WORP				
BIN 32-bit logical OR	DOR		(D+1, D) OR (S+1, S)→(D+1, D)		184
	DORP				
	DOR		(S1+1, S1) OR (S2+1, S2) →(D+1, D)		
	DORP				
BIN 16-bit exclusive OR	WXOR		(D) XOR (S)→(D)		176
	WXORP				
	WXOR		(S1) XOR (S2)→(D)		
	WXORP				
BIN 32-bit exclusive OR	DXOR		(D+1, D) XOR (S+1, S)→(D+1, D)		187
	DXORP				
	DXOR		(S1+1, S1) XOR (S2+1, S2) →(D+1, D)		
	DXORP				

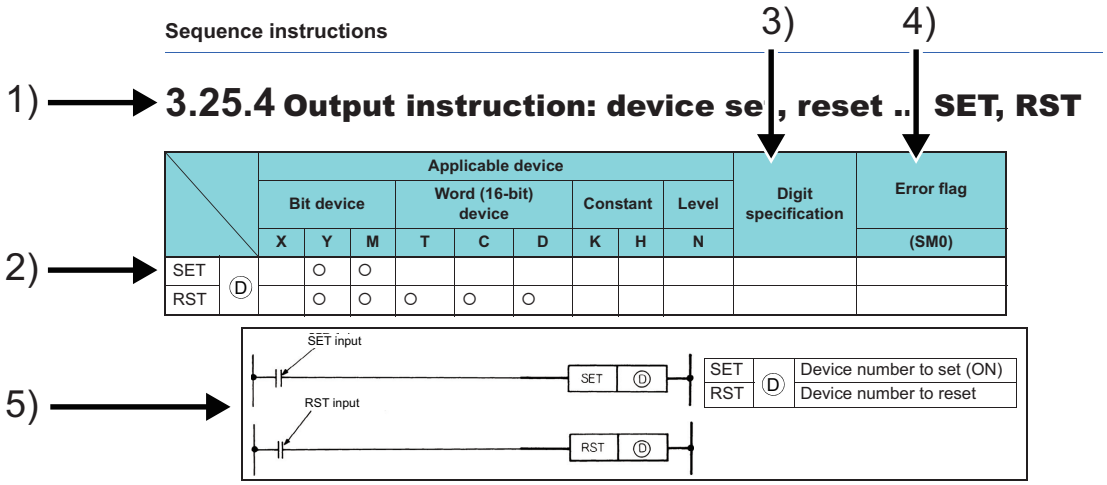
Classification	Instruction symbol	Symbol	Process description	Execution condition	Refer to page
BIN 16-bit exclusive NOR	WXNR	WXNR (S) (D)	$\overline{(D) \text{ XOR } (S)} \rightarrow (D)$		178
	WXNRP	WXNRP (S) (D)			
	WXNR	WXNR (S1) (S2) (D)	$\overline{(S1) \text{ XOR } (S2)} \rightarrow (D)$		
	WXNRP	WXNRP (S1) (S2) (D)			
BIN 32-bit exclusive NOR	DXNR	DXNR (S) (D)	$\overline{(D+1, D) \text{ XOR } (S+1, S)} \rightarrow (D+1, D)$		190
	DXNRP	DXNRP (S) (D)			
	DXNR	DXNR (S1) (S2) (D)	$\overline{(S1+1, S1) \text{ XOR } (S2+1, S2)} \rightarrow (D+1, D)$		
	DXNRP	DXNRP (S1) (S2) (D)			

3.23.5 Display instruction

Classification	Instruction symbol	Symbol	Process description	Execution condition	Refer to page
Character string data transfer	$MOV	$MOV (S) (D)	Character string specified with (S) is transferred to devices after that specified with (D).		192
	$MOVP	$MOVP (S) (D)			
Character string output	G.PRR	G.PRR n (S) (D)	Data stored in the device specified with (S) is sent to PU. (n, (D) are dummies)		193
	GP.PRR	GP.PRR n (S) (D)			
	UMSG	UMSG (S)	Data stored in the device specified with (S) is sent to PU.		

3.24 How to view instructions

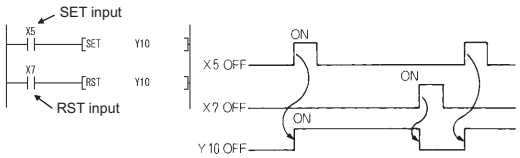
The subsequent descriptions shall be in the following format.



6) ◆Function

SET

- When SET input is turned ON, the specified device turns ON.
- A device that was turned ON remains ON even if the SET input is turned OFF. It can be turned OFF with the RST instruction.



- When the SET input is OFF, the device state does not change.

7) ◆Execution condition

The SET and RST instructions are executed for each scan.

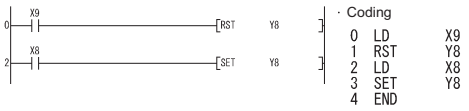
NOTE

- The number of steps is three when the following devices are used.
  SET instruction ... Special relay (M)
  RST instruction ... Special relay (M), all word devices

8) ◆Program example

SET, RST

- Program that sets Y8 (ON) when X8 turns ON, and resets Y8 (OFF) when X9 turns ON.



◆Description

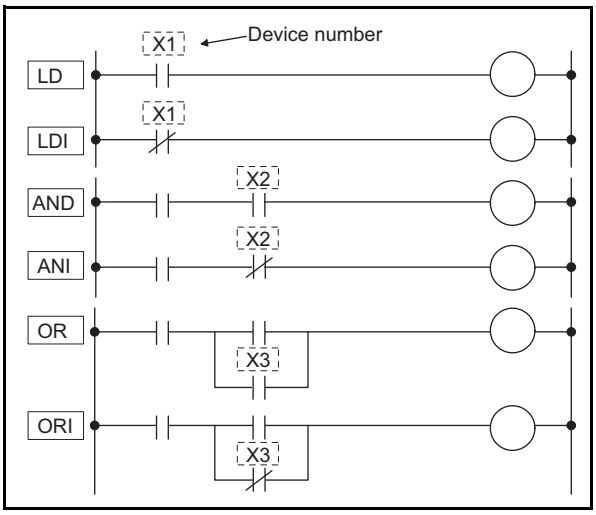
1) Indicates the item number, instruction overview and instruction symbol.
2) Devices that can be used by instructions are marked with ○.
3) When a bit device is used, this indicates digit specifications that can be set in the instruction required by the digit specification.
4) When an operation error occurs, instructions whose error flags turn ON are marked with ○.
5) Indicates the format in ladder mode.
6) Describes the instruction.
7) Indicates the execution conditions of the instruction.
8) Indicates the program example in ladder mode and list mode.

3.25 Sequence instructions

Sequence instructions are used in relay control circuits, etc.

3.25.1 Contact instruction: operation start, series connection, parallel connection ... LD, LDI, AND, ANI, OR, ORI

Applicable device									Digit specification	Error flag
Bit device			Word (16-bit) device			Constant		Level		
X	Y	M	T	C	D	K	H	N		(SM0)
○	○	○	○	○						



◆Function

LD, LDI

- LD is the NO contact operation start instruction and LDI is the NC contact operation start instruction. They import the ON/OFF information of the specified device as the operation result.

AND, ANI

- AND is the NO contact series connection instruction, and ANI is the NC contact series connection. They import the ON/OFF information of the specified device to perform the AND operation with the operation result up to this point and take the resulting value as the operation result.
- There are no usage limitations on AND and ANI, but the following limitations exist in ladder mode.
  - Write: When AND or ANI are connected in a series, a ladder with a maximum of 21 steps can be created.
  - Read: When AND or ANI are connected in a series, a ladder with a maximum of 24 steps can be displayed. If the ladder exceeds 24 steps, steps up to the 24th step are displayed.

OR, ORI

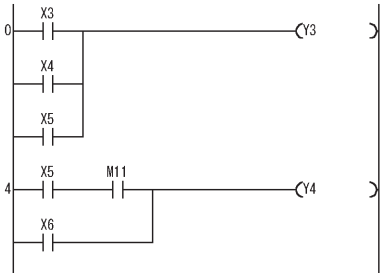
- OR is the parallel connection instruction with a single NO contact, and ORI is the parallel connection instruction with a single NC contact. They import the ON/OFF information of the specified device to perform the OR operation with the operation result up to this point and take the resulting value as the operation result.
- There are no usage limitations on OR and ORI, but the following limitations exist in ladder mode.
  - Write: A ladder that contains 23 OR or ORI continually linked can be created.
  - Read: A ladder that contains 23 OR or ORI continually linked can be displayed. Ladders that contains more than 23 OR or ORI cannot be displayed correctly.

◆Execution condition

The instructions explained in this section are executed every scan irrespective of the device ON/OFF status or the operation result directly prior to the execution.

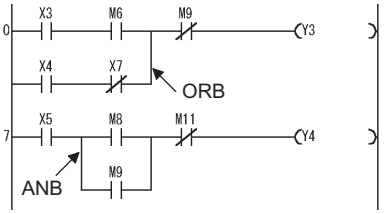
◆Program example

LD , LDI , AND , ANI , OR , ORI



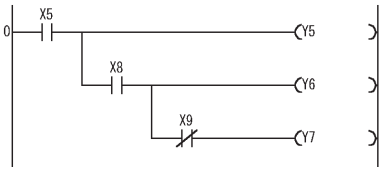
· Coding

```
0   LD      X3
1   OR      X4
2   OR      X5
3   OUT     Y3
4   LD      X5
5   AND     M11
6   OR      X6
7   OUT     Y4
8   END
```



· Coding

```
0   LD      X3
1   AND     M6
2   LD      X4
3   ANI     X7
4   ORB
5   ANI     M9
6   OUT     Y3
7   LD      X5
8   LD      M8
9   OR      M9
10  ANB
11  ANI     M11
12  OUT     Y4
13  END
```

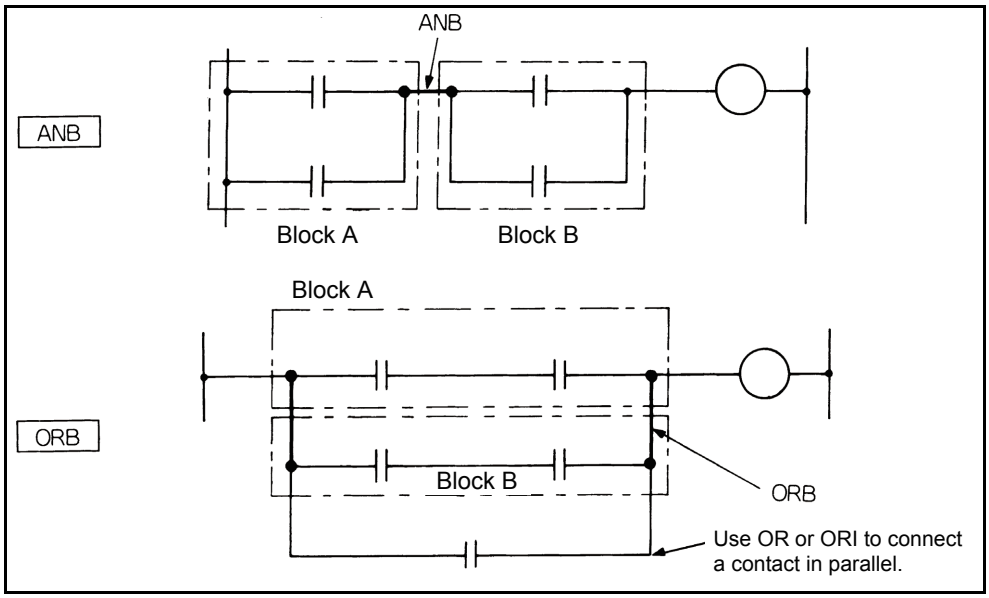


· Coding

```
0   LD      X5
1   OUT     Y5
2   AND     X8
3   OUT     Y6
4   ANI     X9
5   OUT     Y7
6   END
```

3.25.2 Association instruction: ladder block series connection, parallel connection ... ANB, ORB

Applicable device									Digit specification	Error flag
Bit device			Word (16-bit) device			Constant		Level		
X	Y	M	T	C	D	K	H	N		(SM0)



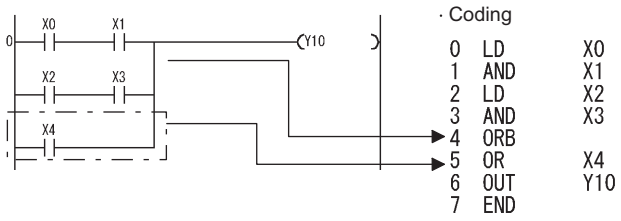
◆Function

ANB

- The AND operation is executed for the A block and B block to produce the operation result.
- The AND symbol is a connection symbol, not a contact symbol.
- A maximum of 7 instructions (8 blocks) can be written continuously for ANB.
  If more ANB instructions than indicated above are written continuously, the PLC function cannot operate correctly.

ORB

- The OR operation is executed for the A block and B block to produce the operation result.
- ORB creates parallel connections with ladder blocks that have two or more contacts. Use OR or ORI to create parallel connections with ladder blocks that only have one contact, there is no need to use ORB.

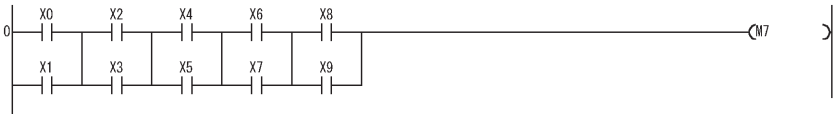


- The ORB symbol is a connection symbol, not a contact symbol.
- A maximum of 7 instructions (8 blocks) can be written continuously for ORB.
  If more ORB than indicated above are written continuously, the PLC function cannot operate correctly.

◆Program example

ANB

The following two types of program coding are available for continuous series connection of ladder blocks. However, the coding example 1 should be applied.



▪ Coding example 1

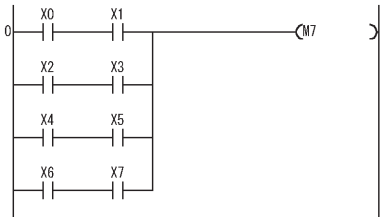
```
 0  LD    X0
 1  OR    X1
 2  LD    X2
 3  OR    X3
 4  ANB
 5  LD    X4
 6  OR    X5
 7  ANB
 8  LD    X6
 9  OR    X7
10  ANB
11  LD    X8
12  OR    X9
13  ANB
14  OUT   M7
15  END
```

▪ Coding example 2

```
 0  LD    X0
 1  OR    X1
 2  LD    X2
 3  OR    X3
 4  LD    X4
 5  OR    X5
 6  LD    X6
 7  OR    X7
 8  LD    X8
 9  OR    X9
10  ANB
11  ANB
12  ANB
13  ANB
14  OUT   M7
15  END
```

ORB

The following two types of program coding are available for continuous parallel connection of ladder blocks. However, the coding example 1 should be applied.



▪ Coding example 1

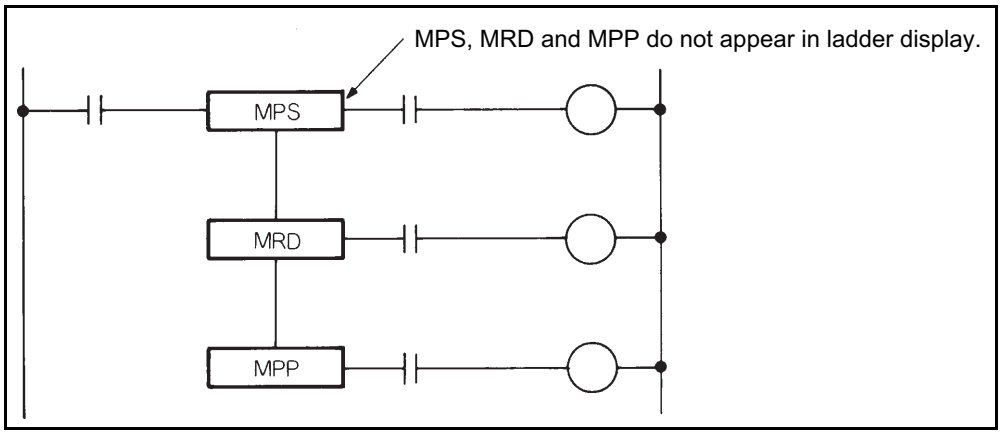
```
 0  LD    X0
 1  AND   X1
 2  LD    X2
 3  AND   X3
 4  ORB
 5  LD    X4
 6  AND   X5
 7  ORB
 8  LD    X6
 9  AND   X7
10  ORB
11  OUT   M7
12  END
```

▪ Coding example 2

```
 0  LD    X0
 1  AND   X1
 2  LD    X2
 3  AND   X3
 4  LD    X4
 5  AND   X5
 6  LD    X6
 7  AND   X7
 8  ORB
 9  ORB
10  ORB
11  OUT   M7
12  END
```

3.25.3 Association instruction: operation results, push, read, pop ... MPS, MRD, MPP

Applicable device									Digit specification	Error flag
Bit device			Word (16-bit) device			Constant		Level		
X	Y	M	T	C	D	K	H	N		(SM0)



◆Function

MPS

- The operation result (ON/OFF) directly prior to the MPS instruction is stored.
- The MPS instruction can be used continuously up to 12 times.
  However, it can only be used up to 11 times when created with ladder mode.
  When the MPP instruction is used during the program, the number of the MPS instructions to be used is reduced by 1.

MRD

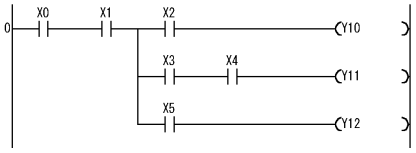
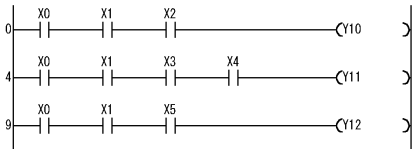
- The operation result stored by the MPS instruction is read, and the operation of the following step is continued by this operation result.

MPP

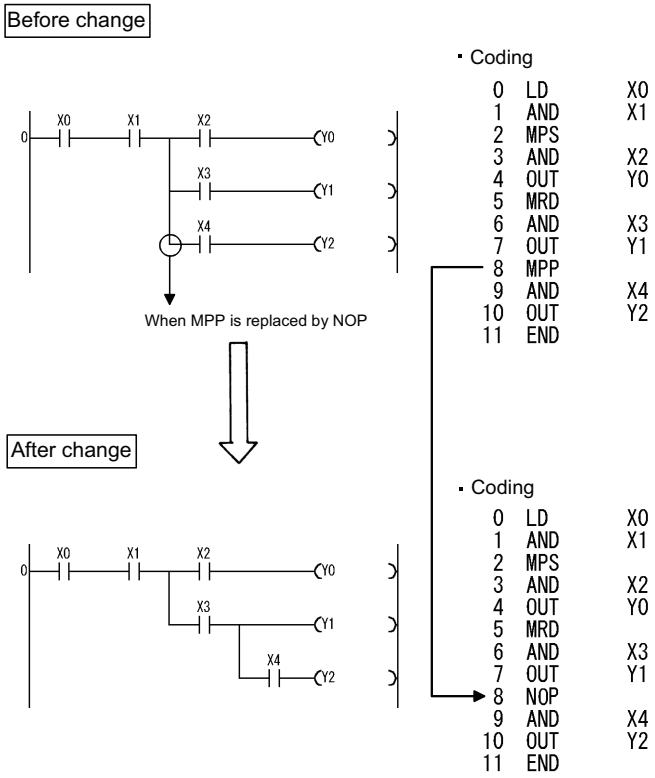
- The operation result stored by the MPS instruction is read, and the operation of the following step is continued by this operation result.
- The operation result stored by the MPS instruction is cleared.

POINT

- The ladder is as shown below when MPS, MRD and MPP are used and when they are not used.

Ladder when MPS, MRD and MPP are used	Ladder when MPS, MRD and MPP are not used
	

- Be sure to match the number of MPS and MPP instructions. The following will occur if the number used is different.
  If the number of MPS instructions is greater, the ladder is changed and the PLC function executes operations on the changed ladder.

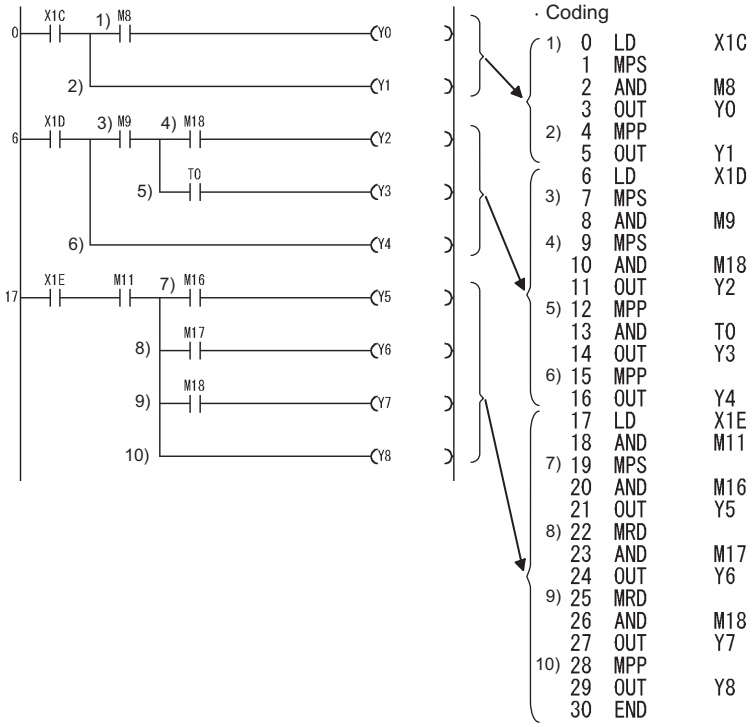


If the number of MPP instructions is greater, a ladder creation failure occurs for that ladder block and the PLC function cannot execute operations normally.

◆Program example

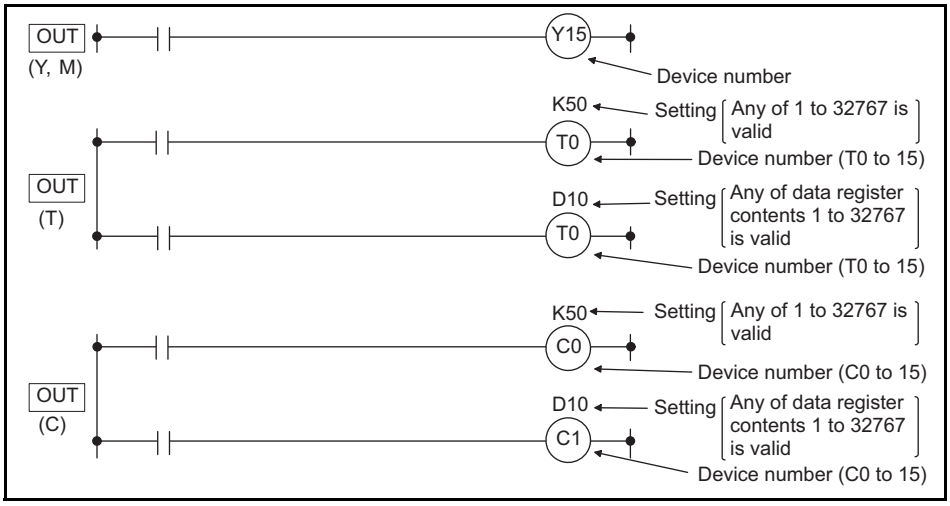
MPS , MRD , MPP

• Program using MPS, MRD and MPP



3.25.4 Output instruction: bit device, timer, counter ... OUT

		Applicable device									Digit specification	Error flag
		Bit device			Word (16-bit) device			Constant		Level		
		X	Y	M	T	C	D	K	H	N		(SM0)
Bit device			○	○								
Timer	Device				○							
	Setting value						○	○				
Counter	Device					○						
	Setting value						○	○				



◆Function

OUT (Y, M)

• Operation results up to the OUT instruction are output to the specified device.

Operation result	OUT instruction		
	Coil	Contact	
		NO contact	NC contact
OFF	OFF	Non-conduction	Conduction
ON	ON	Conduction	Non-conduction

NOTE

• The OUT instruction repuires 3 steps when a special relay (M) is used.

OUT(T)

- When the operation result up to the OUT instruction is ON, the timer coil turns ON and counts up the value up to the setting value. When the coil's timer reaches the setting value (counted value ≥ setting value), the contacts enter the following states:

NO contact	Conduction
NC contact	Non-conduction

- When the operation result up to the OUT instruction changes from ON to OFF, the following occurs.

Type of timer	Timer coil	Present value of timer	Before the time up		After the time up	
			NO contact	NC contact	NO contact	NC contact
100 ms timer	OFF	0	Non-conduction	Conduction	Non-conduction	Conduction
10 ms timer						
100 ms retentive timer	OFF	Retention of present value	Non-conduction	Conduction	Conduction	Non-conduction

- After the timer reaches the setting value, the state of the retentive timer contact does not change until the RST instruction is executed.
- Negative values (-32768 to -1) cannot be set for the setting value.
- The timer's setting value becomes infinity, if its setting value is set to "0". For this reason, the timer does not time up.
- For details on the counting method of the timer, refer to page 87.

OUT (C)

- If the operation result changes from OFF to ON up to the OUT instruction, +1 is added to the present value (count value), and when counting reaches the setting value (present value = setting value), the contact is as follows.

NO contact	Conduction
NC contact	Non-conduction

- The timer will not start counting if the operation result remains ON. (Count input does not need to be converted into pulse form.)
- After a count-up, the count value and state of the contact do not change until the RST instruction is executed.
- Negative values (-32768 to -1) cannot be set for the setting value. Furthermore, if the setting value is 0, the same process as for a setting value of 1 is performed.
- For details on the counting method of the counter, refer to page 89.

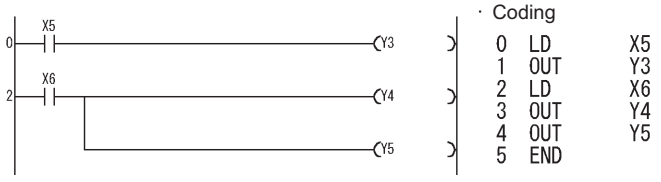
◆Execution condition

The OUT instruction is executed for each scan irrespective of the operation result up to the instruction.

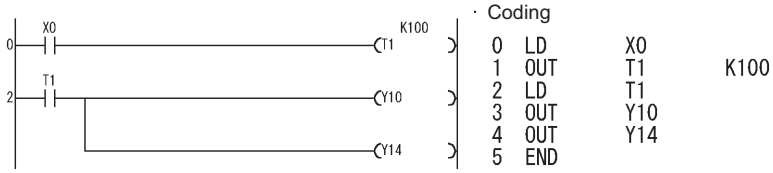
◆Program example

OUT

- Program that outputs to the output module.

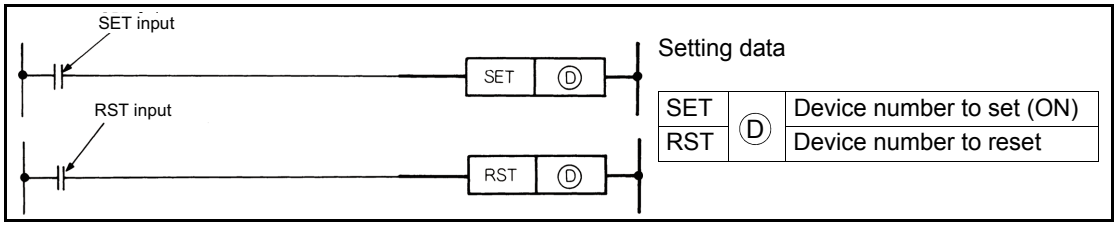


- Program that turns X0 ON, and then 10 seconds later turns Y10 and Y14 ON.



3.25.5 Output instruction: device set, reset ... SET, RST

		Applicable device									Digit specification	Error flag
		Bit device			Word (16-bit) device			Constant		Level		
		X	Y	M	T	C	D	K	H	N		(SM0)
SET	Ⓓ		○	○								
RST	Ⓓ		○	○	○	○	○					



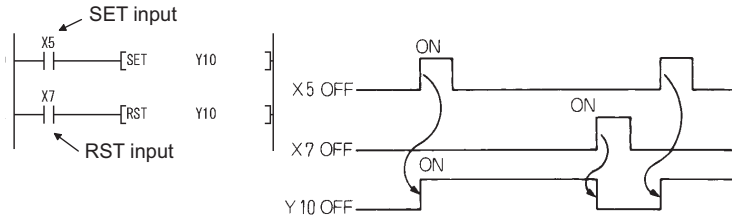
Setting data

SET	Ⓓ	Device number to set (ON)
RST	Ⓓ	Device number to reset

◆Function

SET

- When SET input is turned ON, the specified device turns ON.
- A device that was turned ON remains ON even if the SET input is turned OFF. It can be turned OFF with the RST instruction.



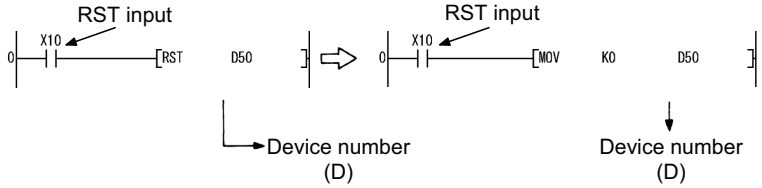
- When the SET input is OFF, the device state does not change.

RST

- When the RST input is turned ON, the specified device is as follows.

Device	Status
Y, M	The coil and contact are turned OFF.
T, C	The present value is set to 0, and the coil and contact are turned OFF.
D	The content is set to 0.

- When the RST input is OFF, the device state does not change.
- The RST (D) function is identical to the following ladder.



◆Execution condition

The SET and RST instructions are executed for each scan.

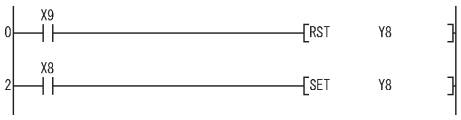
NOTE

- The number of steps is three when the following devices are used.
  SET instruction ... Special relay (M)
  RST instruction ... Special relay (M), all word devices

◆Program example

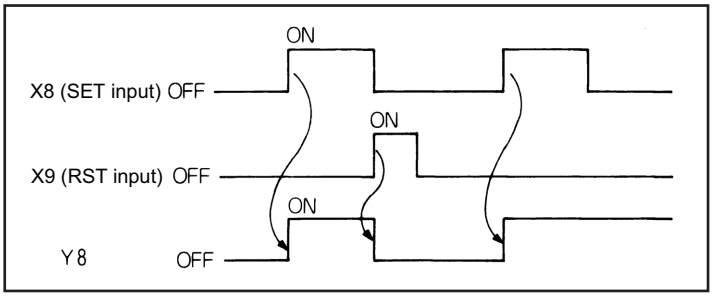
SET , RST

- Program that sets Y8 (ON) when X8 turns ON, and resets Y8 (OFF) when X9 turns ON.



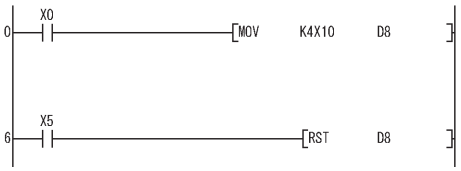
· Coding

```
0  LD    X9
1  RST   Y8
2  LD    X8
3  SET   Y8
4  END
```



Operations of SET and RST instructions

- Program that sets the data register content to 0.



Stores X10 to 1F contents into D8 when X0 turns ON.

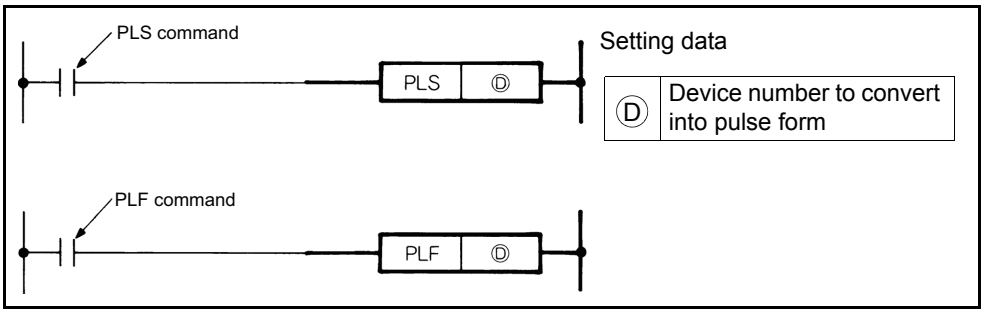
Resets D8 contents to 0 when X5 turns ON.

· Coding

```
0   LD    X0
1   MOV   K4X10   D8
6   LD    X5
7   RST   D8
10  END
```

3.25.6 Output instruction: rising, falling differential output ... PLS, PLF

	Applicable device									Digit specification	Error flag
	Bit device			Word (16-bit) device			Constant		Level		
	X	Y	M	T	C	D	K	H	N		(SM0)
Ⓓ		○	○								

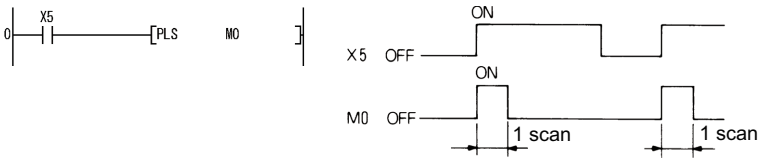


◆Function

PLS

- The specified device is turned ON when the PLS command changes from OFF to ON, and OFF at all times other than when the PLS command is turned OFF to ON (OFF to OFF, ON to ON, ON to OFF).

  If there is one PLS instruction for the device specified by Ⓓ during one scan, the specified device is turned ON for one scan.
  Do not execute the PLS instruction of the same device multiple times during one scan.

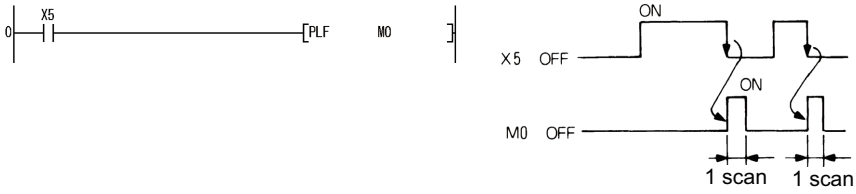


- After the PLS instruction is executed, it will not be executed again even if STOP is executed and RUN is executed again.

PLF

- The specified device is turned ON when the PLF command changes from ON to OFF, and OFF at all times other than when the PLS command is turned ON to OFF (OFF to OFF, OFF to ON, ON to ON).

  If there is one PLF instruction for the device specified by Ⓓ during one scan, the specified device is turned ON for one scan.
  Do not execute the PLF instruction of the same device multiple times during one scan.

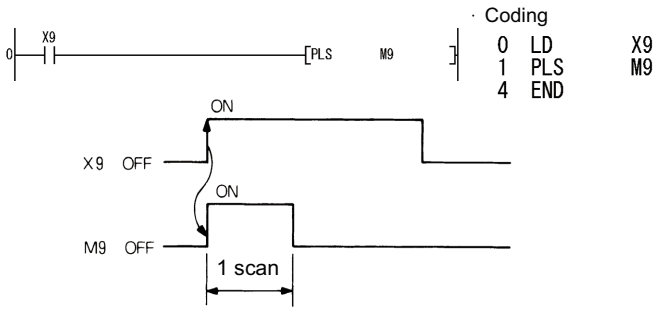


- After the PLF instruction is executed, it will not be executed again even if STOP is executed and RUN is executed again.

◆Program example

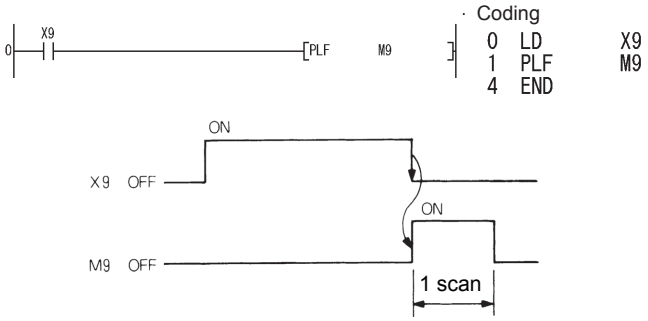
PLS

Program that executes the PLS instruction when X9 is turned ON.



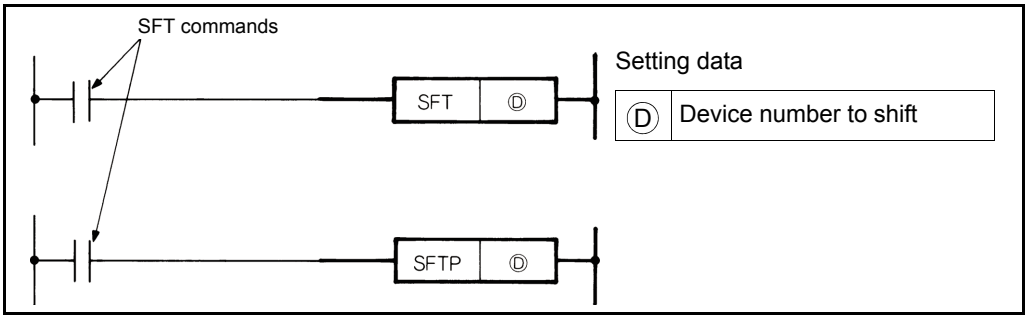
PLF

Program that executes the PLF instruction when X9 is turned OFF.



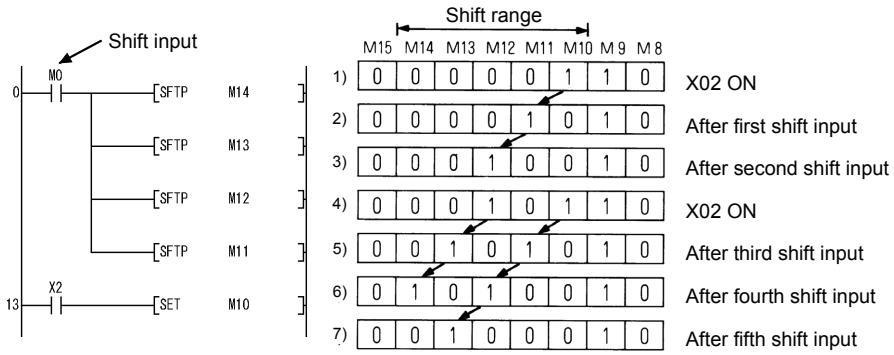
3.25.7 Shift instruction: bit device shift ... SFT, SFTP

	Applicable device									Digit specification	Error flag
	Bit device			Word (16-bit) device			Constant		Level		
	X	Y	M	T	C	D	K	H	N		(SM0)
Ⓓ		○	○								



◆Function

- The ON/OFF status is shifted to the device immediately prior to the device specified with Ⓓ, and the prior device is set to OFF.
- Use the SET instruction to turn ON the start device to be shifted.
- When SFT or SFTP are used continuously, start programming from larger device numbers.

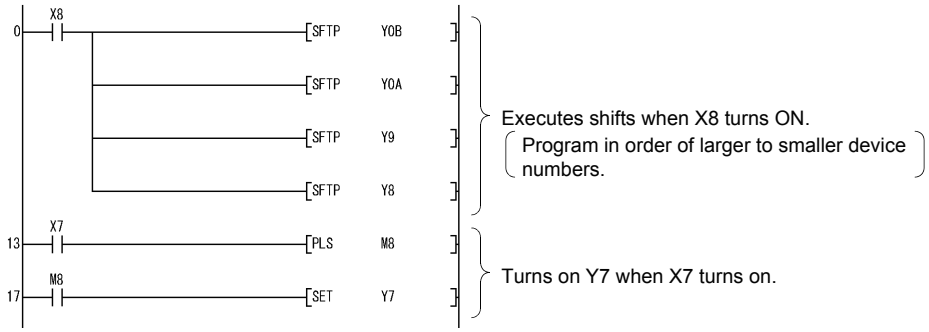

Shift input
Shift range
M15 M14 M13 M12 M11 M10 M9 M8
0
M0
SFTP M14
SFTP M13
SFTP M12
SFTP M11
13
X2
SET M10
1) 0 0 0 0 0 1 1 0 X02 ON
2) 0 0 0 0 1 0 1 0 After first shift input
3) 0 0 0 1 0 0 1 0 After second shift input
4) 0 0 0 1 0 1 1 0 X02 ON
5) 0 0 1 0 1 0 1 0 After third shift input
6) 0 1 0 1 0 0 1 0 After fourth shift input
7) 0 0 1 0 0 0 1 0 After fifth shift input

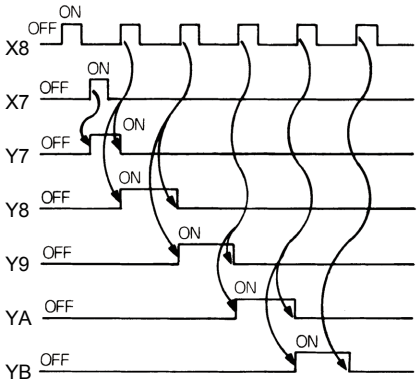
∗1 At M8 to 15, 1 indicates ON and 0 indicates OFF.

◆Program example

SFT

• Program that shifts Y7 to YB when X8 turns ON.



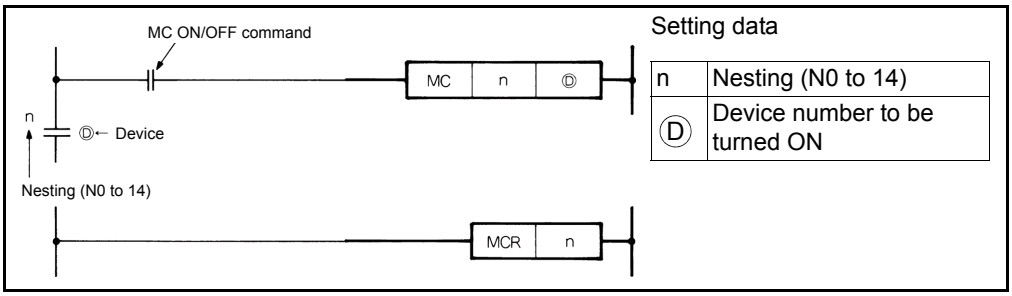


• Coding

```
 0  LD      X8
 1  SFTP    Y0B
 4  SFTP    Y0A
 7  SFTP    Y9
10  SFTP    Y8
13  LD      X7
14  PLS     M8
17  LD      M8
18  SET     Y7
19  END
```

3.25.8 Master control instruction: master control set, reset ... MC, MCR

	Applicable device									Digit specification	Error flag
	Bit device			Word (16-bit) device			Constant		Level		
	X	Y	M	T	C	D	K	H	N		(SM0)
n									○		
Ⓓ		○	○								

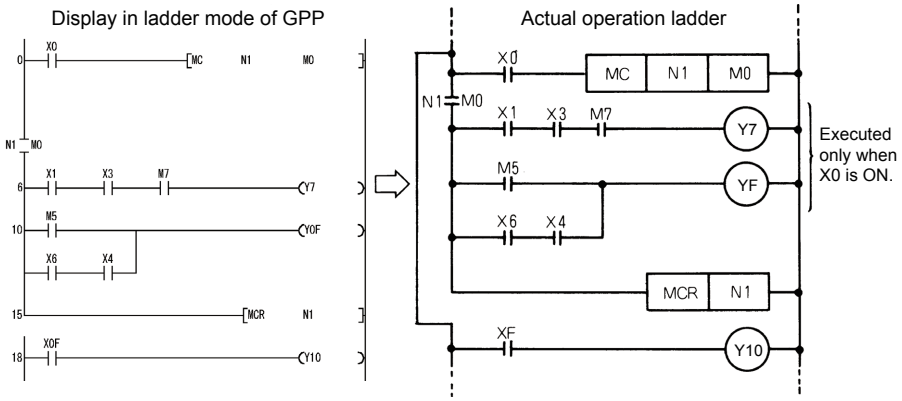


Setting data

n	Nesting (N0 to 14)
Ⓓ	Device number to be turned ON

◆Function

- This instruction is for creating an efficient ladder switching sequence program by opening and closing the common bus of the ladder using the master control instruction. The following ladders use the master control.



MC

- When the MC ON/OFF instruction is turned ON at the start of master control, the operation results from MC to MCR are as per the instruction (ladder).
- Even when the MC instruction is OFF, the scan time is not shortened because the scan is executed between the MC instruction and MCR instruction.
  Also, when the MC instruction is OFF, the operation results of MC and MCR are as follows.

100 ms, 10 ms timer	The count value becomes 0, and both coil and contact turn OFF.
100 ms retentive timer, counter	The coil turns OFF, but the count value and contact both retain the current state.
Device currently under OUT instruction	All turn OFF.
SET, RST or SFT, or devices currently executing basic or application instructions	Retain the current state.

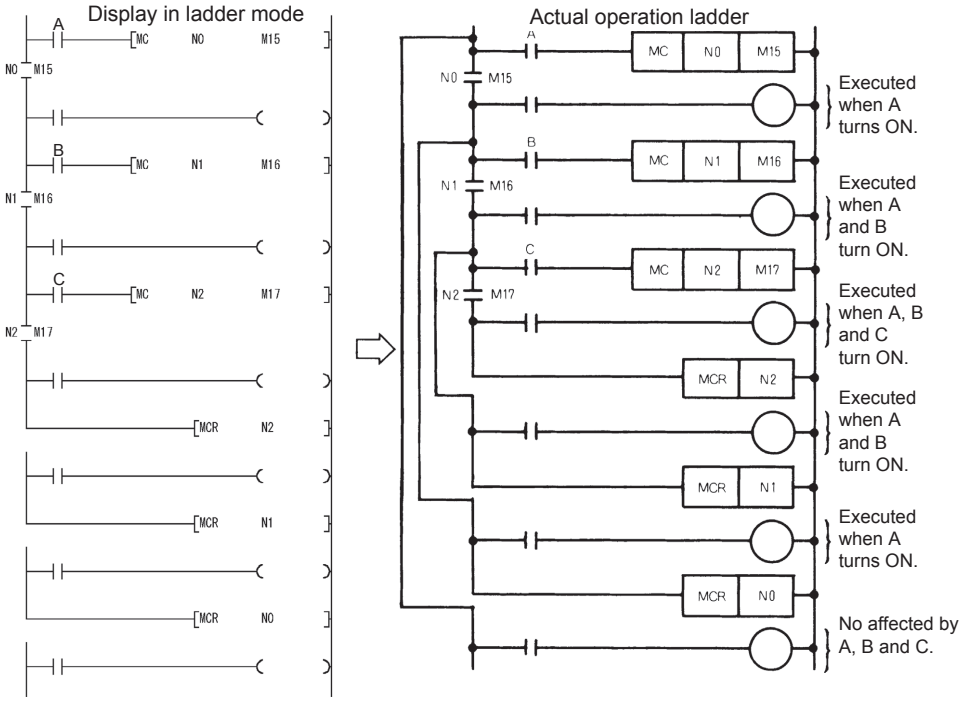
- The MC instruction can use the same nesting (N) number any number of times by changing the Ⓓ device.
- When the MC instruction is ON, the coil of the device specified by Ⓓ is ON. Furthermore, as a double coil occurs when the same device is used by instructions such as the OUT instruction, do not use a device specified by Ⓓ when it is executing a different instruction.

MCR

- The master control release instruction that indicates the end of the master control range.
- Do not add a contact instruction to the front of the MCR instruction.

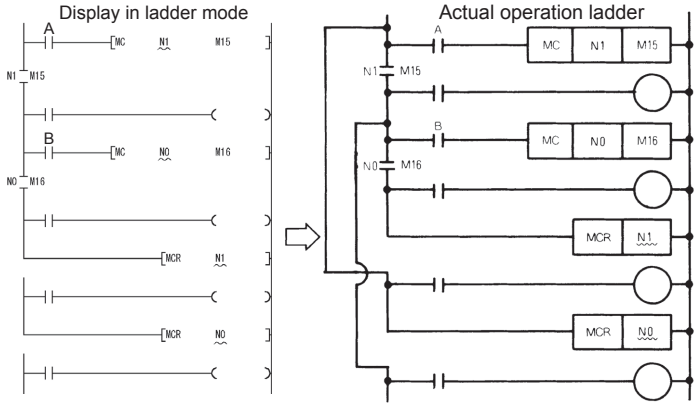
◆Program example

- The master control instruction can be used as a nesting structure. Each master control area is separated by nesting (N). N0 to N14 can be used for nesting.
  A ladder in which the program execution conditions are limited successively can be created by using the nesting structure.
  A ladder that uses a nesting structure is as follows.



Take note of the following points when using a nesting structure.

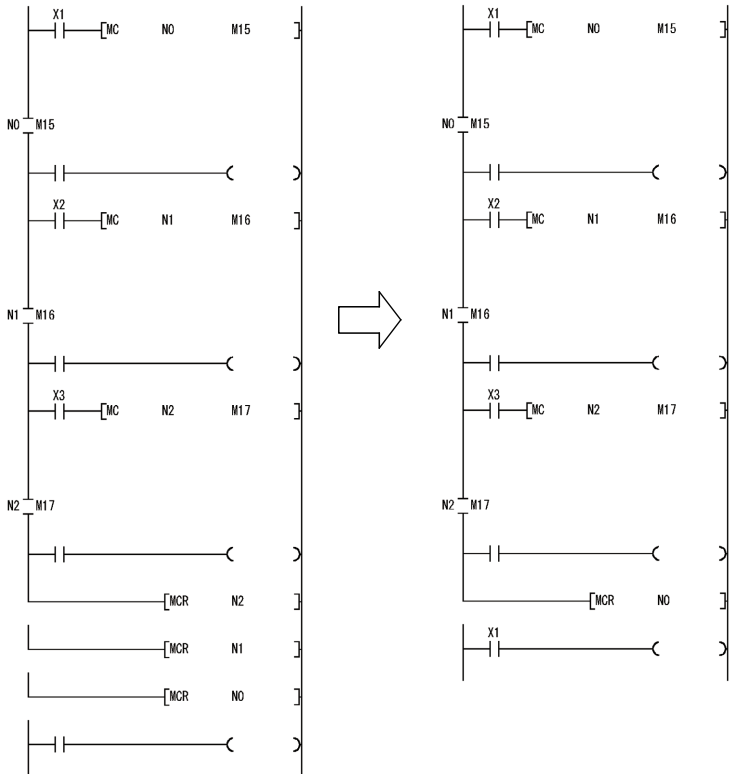
- A maximum of 15 nests (N0 to 14) can be used. When applying nesting, MC uses numbers from the lower nesting (N) numbers upwards, whereas MCR uses numbers from the higher numbers downwards. If the order is reversed, the structure is not a nesting structure and the PLC function cannot operate normally.



Nesting numbers of MCR are opposite.

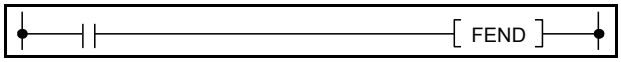
Since buses cross each other, normal master control ladder cannot be created.

- If the nesting structure consists of MCR instructions collected in one location, the single lowest nesting (N) number can be used to terminate all master controls.



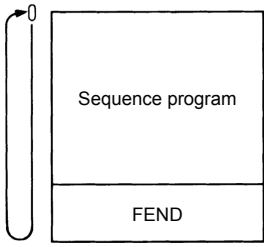
3.25.9 Termination instruction: termination of main program ... FEND

Applicable device									Digit specification	Error flag
Bit device			Word (16-bit) device			Constant		Level		
X	Y	M	T	C	D	K	H	N		(SM0)



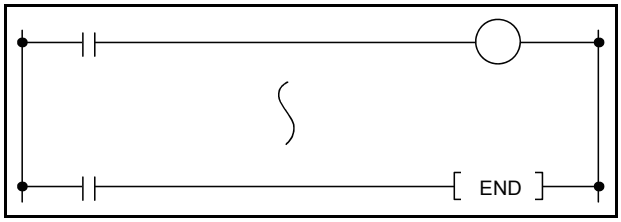
◆Function

- Execution of the FEND instruction will cause the CPU module to terminate the program it was executing.
- Even sequence programs following the FEND instruction can be displayed in ladder display at a peripheral device. (Peripheral devices continue to display ladders until encountering the END instruction.)



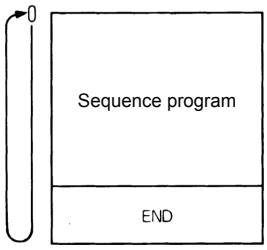
3.25.10 Termination instruction: sequence program termination ... END

Applicable device									Digit specification	Error flag
Bit device			Word (16-bit) device			Constant		Level		
X	Y	M	T	C	D	K	H	N		(SM0)



◆Function

- Indicates the end of a program. Scanning terminates with this step, and returns to step 0.



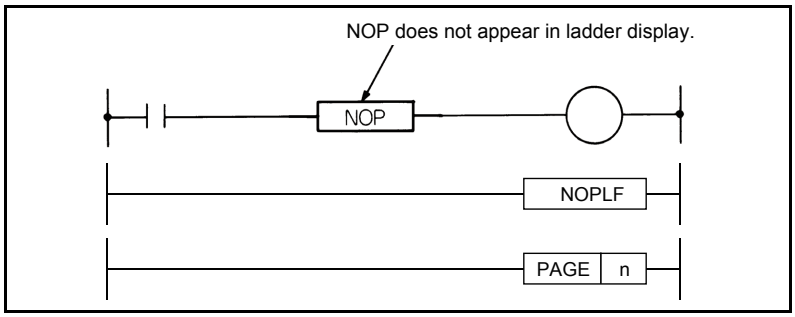
- The END instruction cannot be used during the sequence program.

NOTE

- An operation error occurs if there is no END instruction during the program, and the PLC function does not operate.

3.25.11 Other instructions: non-processing ... NOP, NOPLF, PAGE n

Applicable device									Digit specification	Error flag
Bit device			Word (16-bit) device			Constant		Level		
X	Y	M	T	C	D	K	H	N		(SM0)
										○



◆Function

NOP

Non-processing instructions do not have an effect on previously executed operations.

NOP are used in the following situations.

- Creating space for sequence program debugging.
- Deleting instructions without changing the number of steps. (Replaced by NOP)
- Temporarily deleting instructions.

NOPLF

This is a no operation instruction that has no impact on any operations up to that point.

The NOPLF instruction is used when printing from a peripheral device to force a page change at any desired location.

- When printing ladders
  - A page break will be inserted between ladder blocks with the presence of the NOPLF instruction.
  - The ladder cannot be displayed correctly if an NOPLF instruction is inserted in the midst of a ladder block.
  - Do not insert an NOPLF instruction in the midst of a ladder block.
- When printing instruction lists
  - The page will be changed after the printing of the NOPLF instruction.

Refer to the Operating Manual for the peripheral device in use for details of printouts from peripheral devices.

PAGE n

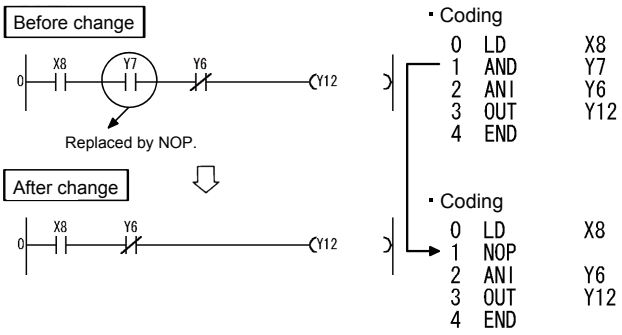
This is a no operation instruction that has no impact on any operations up to that point.

No processing is performed at peripheral devices with this instruction.

◆Program example

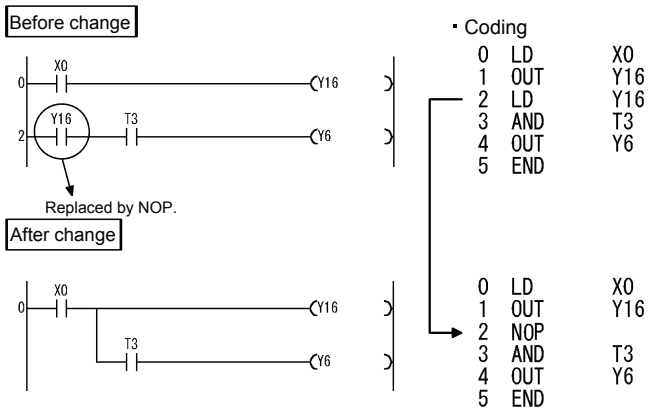
NOP

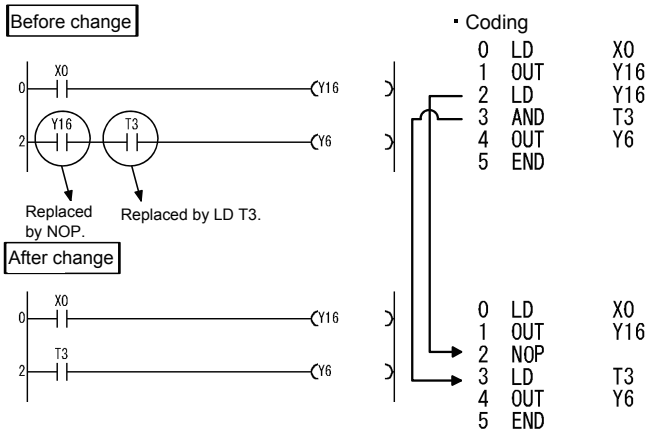
• Contact short-circuit (AND, ANI)



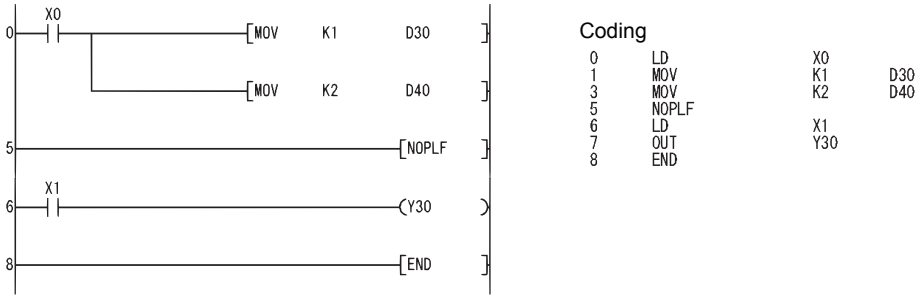
• Contact short-circuit (LD, LDI)

Caution is required because the ladder completely changes if LD or LDI are replaced by NOP.

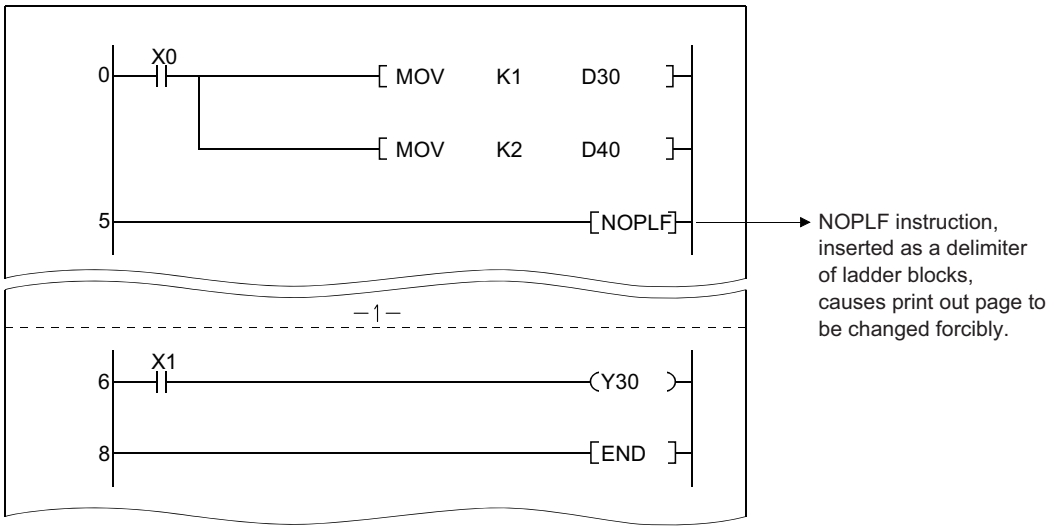




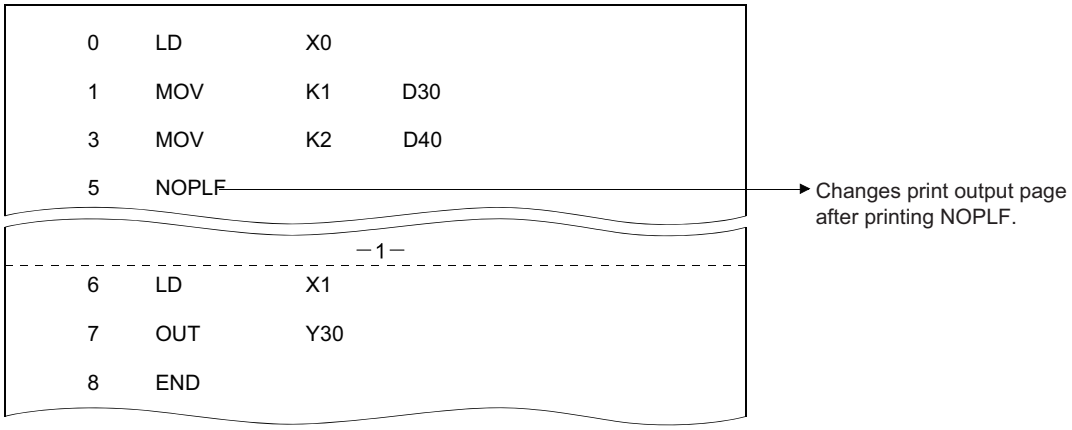
NOPLF



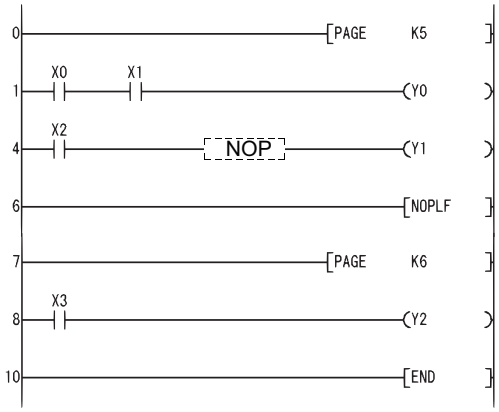
- Printing the ladder will result in the following:



- Printing an instruction list with the NOPLF instruction will result in the following:



PAGE n



Coding

0	PAGE	K5
1	LD	X0
2	AND	X1
3	OUT	Y0
4	LD	X2
5	NOP	
6	OUT	Y1
7	NOPLF	
8	PAGE	K6
9	LD	X3
10	OUT	Y2
11	END	

3.26 Basic instruction (16-bit)

The basic instruction (16-bit) can handle 16 bits of numeric data.

3.26.1 Comparison operation instruction

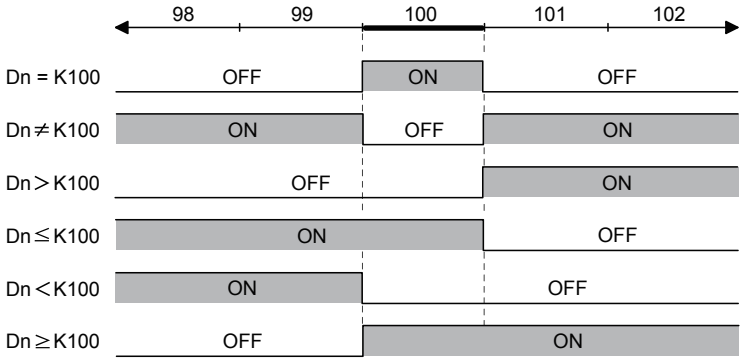
- Comparison operation instructions execute size comparisons (=, >, < etc.) of two data, and instructs a contact to turn ON when the conditions are met.

- The usage method of comparison operation instructions is the same as the contact instructions of sequence instructions, and is as follows.
  - LD, LDI: LD=
  - AND, ANI: AND=
  - OR, ORI: OR=

- There are 18 types of comparison operation instruction as shown below.
  For details, refer to page 140.

Classification	Instruction symbol	Classification	Instruction symbol	Classification	Instruction symbol
=	LD=	>	LD>	<	LD<
	AND=		AND>		AND<
	OR=		OR>		OR<
≠	LD<>	≤	LD<=	≥	LD>=
	AND<>		AND<=		AND>=
	OR<>		OR<=		OR>=

- The conditions for turning comparison operation instructions ON are as follows.

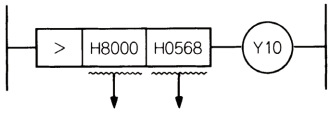


NOTE

- The comparison instruction assumes the specified data as a BIN value for comparison. For this reason, when performing hexadecimal comparison, when the value whose most significant bit (b15) is 1 (8 to F), the BIN value is assumed as a negative number for the comparison.

Example

Comparison of HEX / 4-digit value

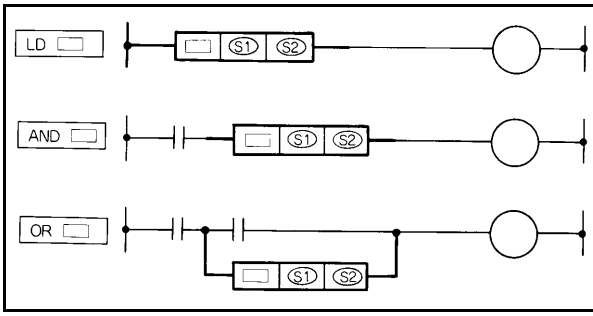


Regarded as -32767 in BIN. Regarded as 1384 in BIN.

Therefore, -32767 < 1384, and Y10 does not turn ON.

3.26.2 Comparison operation instruction: 16-bit data comparison ... =, <>, >, <=, <, >=

	Applicable device									Digit specification	Error flag
	Bit device			Word (16-bit) device			Constant		Level		
	X	Y	M	T	C	D	K	H	N		(SM0)
(S1)	○	○	○	○	○	○	○	○		K1 to K4	○
(S2)	○	○	○	○	○	○	○	○			



Instruction symbol inside

=, <>, >, <=, <, >=

Setting data

(S1)	Start number of the comparison data or the device in which the comparison data is stored
(S2)	

◆Function

- 16-bit comparison operation is handled as NO contact.
- Comparison operation results are as follows.

Instruction symbol inside	Condition	Comparison operation results
=	(S1) = (S2)	Conducted
<>	(S1) ≠ (S2)	
>	(S1) > (S2)	
<=	(S1) ≤ (S2)	
<	(S1) < (S2)	
>=	(S1) ≥ (S2)	

Instruction symbol inside	Condition	Comparison operation results
=	(S1) ≠ (S2)	Not conducted
<>	(S1) = (S2)	
>	(S1) ≤ (S2)	
<=	(S1) > (S2)	
<	(S1) ≥ (S2)	
>=	(S1) < (S2)	

◆Execution condition

The execution conditions for LD ☐, AND ☐ and OR ☐ are as follows.

Instruction	Execution condition
LD ☐	Each scan execution
AND ☐	Executed when the previous contact instruction is ON
OR ☐	Each scan execution

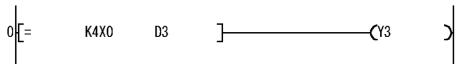
NOTE

- When the digit setting of a bit device is other than K4 and a start bit device value is other than a multiple of 8, the number of steps is 7.

◆Program example

=

Program that compares the X0 to F data with D3 data.



· Coding

```
0  LD=    K4X0   D3
5  OUT    Y3
6  END
```

<>

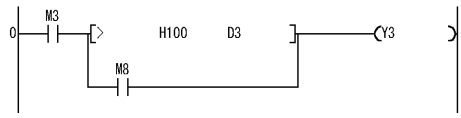
Program that compares the BCD value 100 with D3 data.

· Coding

```
0  LD     M3
1  AND<>  H100   D3
6  OUT    Y3
7  END
```

>

Program that compares the BIN value 100 with D3 data.

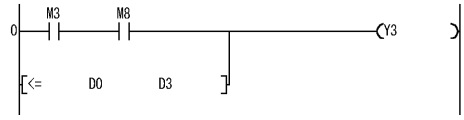


· Coding

```
0  LD     M3
1  LD>    H100   D3
6  OR     M8
7  ANB
8  OUT    Y3
9  END
```

<=

Program that compares the D0 with D3 data.



· Coding

```
0  LD     M3
1  AND    M8
2  OR<=   D0     D3
7  OUT    Y3
8  END
```

3.26.3 Arithmetic operation instruction

An arithmetic operation instruction instructs the addition, subtraction, multiplication or division for two BIN data, or operation of increment or decrement.

◆BIN arithmetic operation (binary)

- If the operation result of an addition instruction exceeds 32767, the value is negative.
- If the operation result of a subtraction instruction is smaller than -32768, the value is positive.
- Operations of positive values and negative values are as follows.

  5 + 8 → 13

  5 - 8 → -3

  5 × 3 → 15

  -5 × 3 → -15

  -5 × (-3) → 15

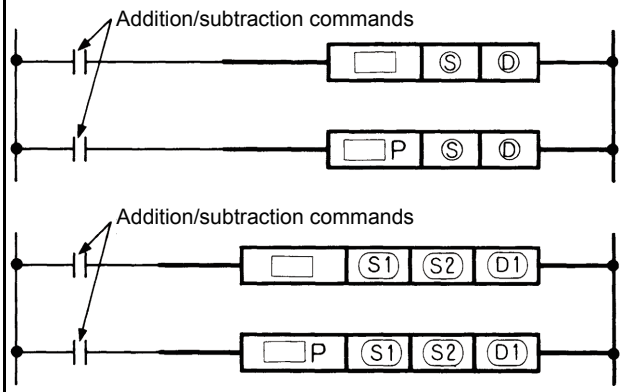
  -5 ÷ 3 → -1 remainder -2

  5 ÷ (-3) → -1 remainder 2

  -5 ÷ (-3) → 1 remainder -2

3.26.4 Arithmetic operation instruction: BIN 16-bit addition/subtraction ... +, +P, -, -P

	Applicable device									Digit specification	Error flag
	Bit device			Word (16-bit) device			Constant		Level		
	X	Y	M	T	C	D	K	H	N		(SM0)
Ⓢ	○	○	○	○	○	○	○	○		K1 to K4	○
Ⓓ		○	○	○	○	○					
Ⓢ1	○	○	○	○	○	○	○	○			
Ⓢ2	○	○	○	○	○	○	○	○			
Ⓓ1		○	○	○	○	○					



Instruction symbol inside □

+, -

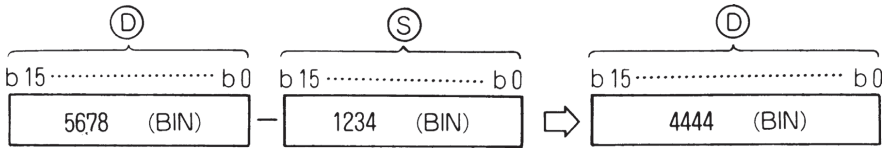
Setting data

Ⓢ	Start number of the addition/ subtraction data or the device in which the addition/subtraction data is stored
Ⓓ	Start number of the device in which the added/subtracted data is stored
Ⓢ1	Start number of the added/ subtracted data or the device in which the added/subtracted data is stored
Ⓢ2	Start number of the addition/ subtraction data or the device in which the addition/subtraction data is stored
Ⓓ1	Start number of the device in which the addition/subtraction results are stored

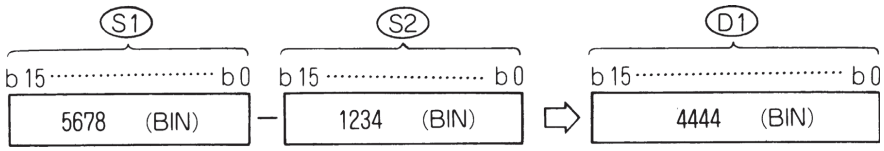
◆Function

+

- Executes addition of the BIN data specified with (D) and BIN data specified with (S), and stores the addition results in the device specified with (D).



- Executes addition of the BIN data specified with (S1) and BIN data specified with (S2), and stores it in the device specified with (D1).

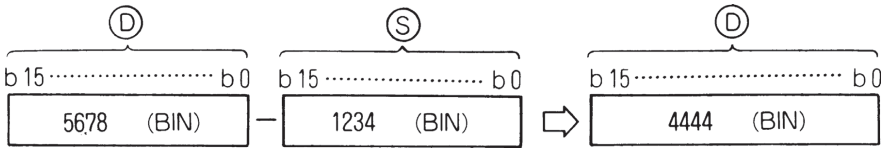


- -32768 to 32767 (BIN 16-bit) can be specified in (S), (S1), (S2) or (D).
- Positive/negative judgment of the (S), (S1), (S2) and (D) data is performed by the most significant bit (b15). (0: positive, 1: negative)
- The carry flag does not turn ON for the 0-bit underflow. The carry flag does not turn ON for the 15th bit overflow. (There is no carry flag)

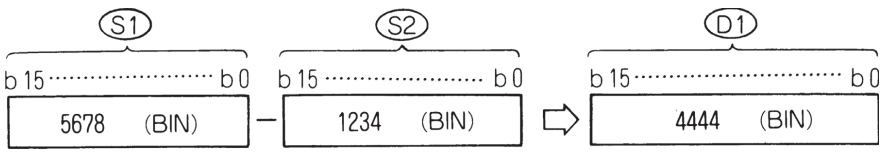
◆Function

-

- Executes subtraction of the BIN data specified with (D) and BIN data specified with (S), and stores the subtraction results in the device specified with (D).



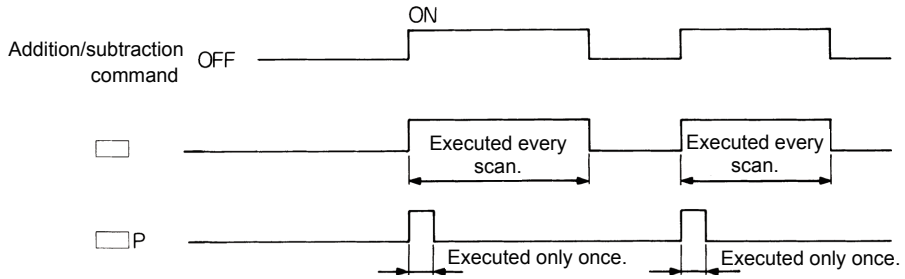
- Executes subtraction of the BIN data specified with (S1) and BIN data specified with (S2), and stores it in the device specified with (D1).



- -32768 to 32767 (BIN 16-bit) can be specified in (S), (S1), (S2) or (D).
- Positive/negative judgment of the (S), (S1), (S2) and (D) data is performed by the most significant bit (b15). (0: Positive, 1: negative)
- The carry flag does not turn ON for the 0-bit underflow. The carry flag does not turn on for the 15th bit overflow. (There is no carry flag)

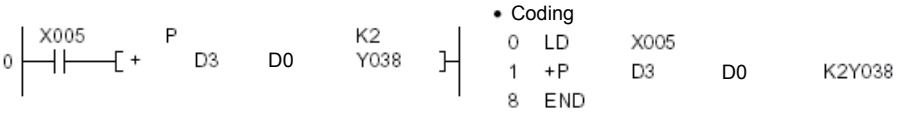
◆Execution condition

Addition/subtraction instruction



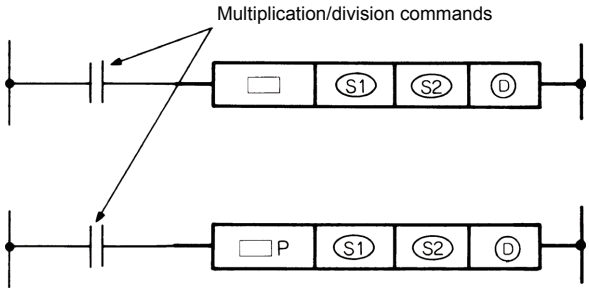
◆Program example

Program that adds the content of D3 to the content of D0 when X5 turns ON, and outputs the results to Y38 to 3F.



3.26.5 Arithmetic operation instruction: BIN 16-bit multiplication/division ... *, *P, /, /P

	Applicable device									Digit specification	Error flag
	Bit device			Word (16-bit) device			Constant		Level		
	X	Y	M	T	C	D	K	H	N		(SM0)
(S1)	○	○	○	○	○	○	○	○		K1 to K4	○
(S2)	○	○	○	○	○	○	○	○			
(D)		○	○	○	○	○					



Instruction symbol inside ☐

*, /

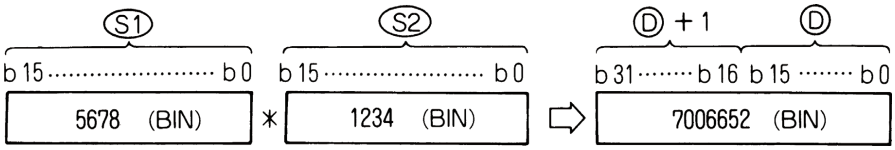
Setting data

(S1)	Start number of the multiplied/ divided data or the device in which the multiplied/divided data is stored
(S2)	Start number of the multiplication/ division data or the device in which the multiplication/division data is stored
(D)	Start number of the device in which the multiplication/division results are stored

◆Function

*

- Executes multiplication of the BIN data specified with (S1) and BIN data specified with (S2), and stores the multiplication results in the device specified with (D).



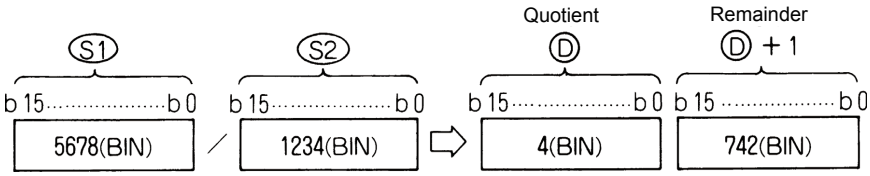
- When (D) is a bit device, specify from the lower bits.
  Example
  K1: Lower 4 bits (b0 to 3)
  K4: Lower 16 bits (b0 to 15)

- -32768 to 32767 (BIN 16-bit) can be specified in (S1) or (S2).

- Positive/negative judgment of the data is performed by the most significant bit (b15) for (S1) and (S2), and (b31) for (D).
  (0: Positive, 1: negative)

/

- Executes division of the BIN data specified with (S1) and BIN data specified with (S2), and stores the division results in the device specified with (D).



- The division results are stored as the quotient and remainder using 32 bits for a word device, or stored as only the quotient using 16 bits for a bit device.

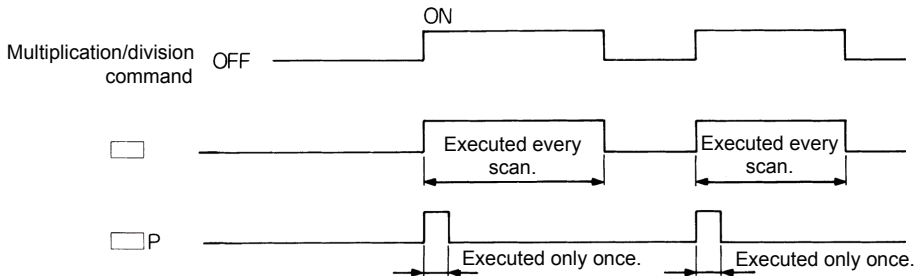
  Quotient: Stored in the lower 16 bits.
  Remainder: Stored in the upper 16 bits. (Only stored for word devices.)

- -32768 to 32767 (BIN 16-bit) can be specified in (S1) or (S2).

- Positive/negative judgment of the (S1), (S2), (D) and (D)+1 data is performed by the most significant bit (b15).
  (Both quotient and remainder have a sign.)
  (0: positive, 1: negative)

◆Execution condition

The execution conditions for multiplication/division instructions are as follows.



◆Operation error

An operation error occurs in the following cases, and the error flag turns on.

- When A1 or V are specified for (D).
- When the divisor (S2) is 0.

◆Program example

*

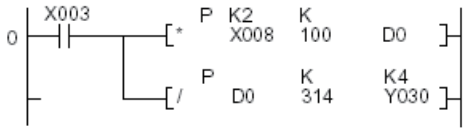
- Program that stores the multiplication results of BIN 5678 and 1234 in D3 and 4 when X5 turns on.

- Coding

```
0   LD    X005
1   *P    K5678   K1234   D3
8   END
```

/

Program that outputs the results of dividing the X8 to F data by 3.14 to Y30 to 3F when X3 turns on.

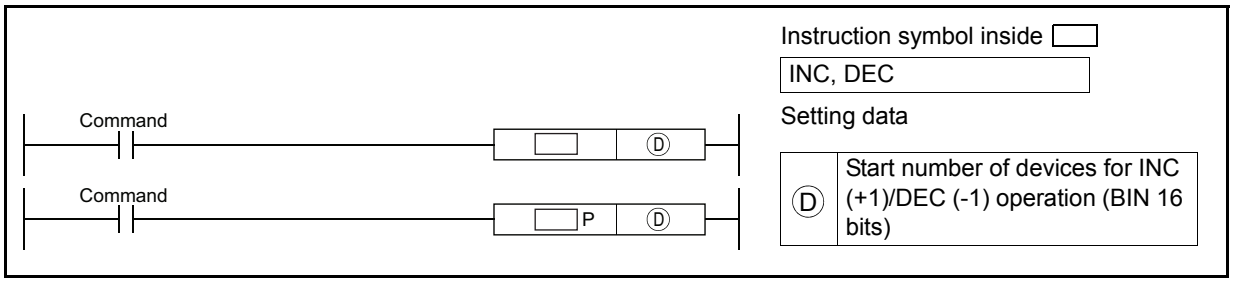


- Coding

```
0   LD    X003
1   *P    K2X008   K100   D0
8   /P    D0       K314   K4Y030
15  END
```

3.26.6 Arithmetic operation instruction: BIN 16-bit data increment/decrement ... INC, INCP, DEC, DECP

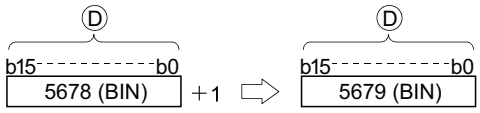
		Applicable device									Digit specification	Error flag
		Bit device			Word (16-bit) device			Constant		Level		
		X	Y	M	T	C	D	K	H	N		(SM0)
INC, INCP, DEC, DECP	Ⓓ	○	○	○	○	○	○				K1 to K4	○



◆Function

INC

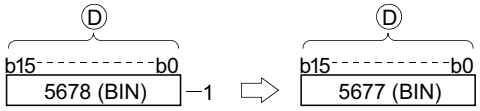
- Adds 1 to the device designated by Ⓓ (16-bit data).



- When INC/INCP operation is executed for the device designated by Ⓓ, whose content is 32767, the value -32768 is stored at the device designated by Ⓓ.

DEC

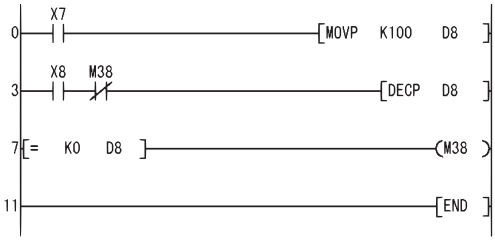
- Subtracts 1 from the device designated by Ⓓ (16-bit data).



- When DEC/DECP operation is executed for the device designated by , whose content is -32768, the value 32767 is stored at the device designated by Ⓓ.

◆Program Example

The following is a down counter program.



Transfers 100 to D8 when X7 goes ON.

In the state M38=OFF, decrement at D8 (D8 - 1) is executed when X8 goes from OFF to ON.

At D8=0, M38 goes ON.

Coding

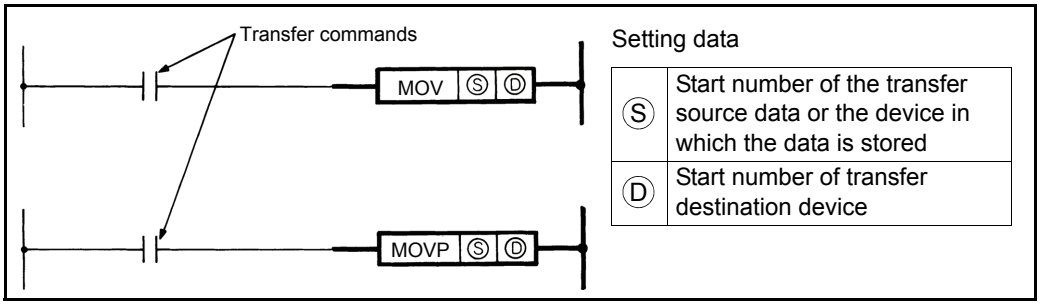
```
0   LD    X7
1   MOVP  K100
3   LD    X8
4   ANI   M38
5   DECP  D8
7   LD=   K0
10  OUT   M38
11  END
```

3.26.7 Data transfer instruction

The data transfer instruction is an instruction that executes the transfer of data.
Data transferred by the data transfer instruction is retained until new data is transferred.

3.26.8 Data transfer instruction: 16-bit data transfer ... MOV, MOVP

		Applicable device									Digit specification	Error flag
		Bit device			Word (16-bit) device			Constant		Level		
		X	Y	M	T	C	D	K	H	N		(SM0)
MOV, MOVP	Ⓢ	○	○	○	○	○	○	○	○		K1 to K4	○
	Ⓓ		○	○	○	○	○					



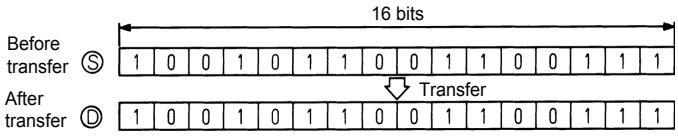
Setting data

Ⓢ	Start number of the transfer source data or the device in which the data is stored
Ⓓ	Start number of transfer destination device

◆Function

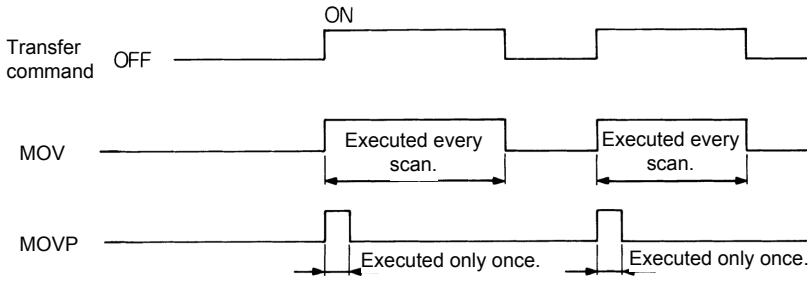
MOV

16-bit data from the device specified with Ⓢ is transferred to the device specified with Ⓓ.



◆Execution condition

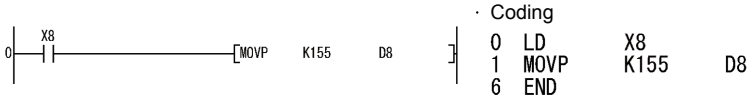
The execution conditions for transfer instructions are as follows.



◆Program example

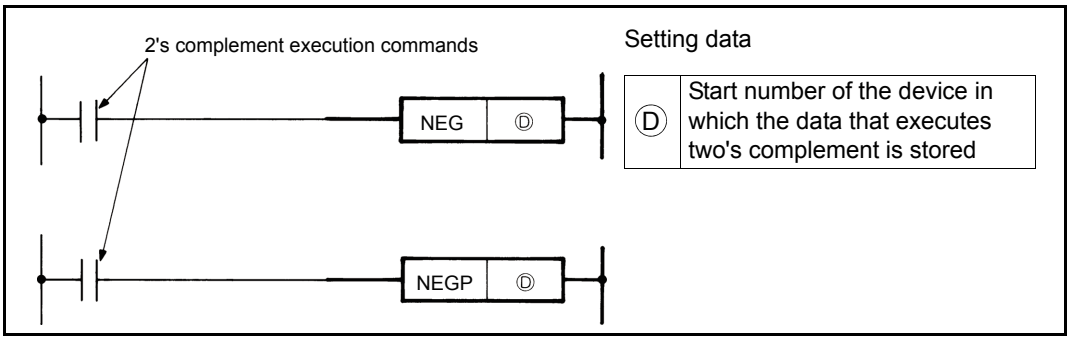
MOV

• Program that stores 155 as a binary value in D8 when X8 turns ON.



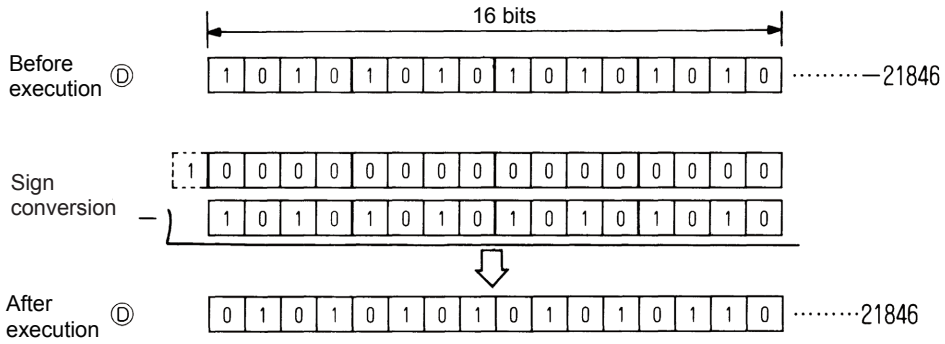
3.26.9 Data conversion instruction: 2's complements of BIN 16-bit data ... NEG, NEGP

		Applicable device									Digit specification	Error flag
		Bit device			Word (16-bit) device			Constant		Level		
		X	Y	M	T	C	D	K	H	N		(SM0)
NEG	Ⓓ		○	○	○	○	○	○	○		K1 to K4	○



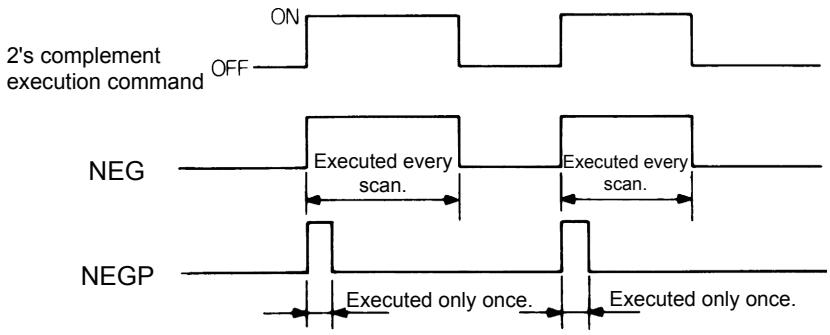
◆Function

- Invert the sign of the 16-bit device specified with Ⓓ, and store the device specified with Ⓓ.



- This is used when inverting the positive/negative signs.

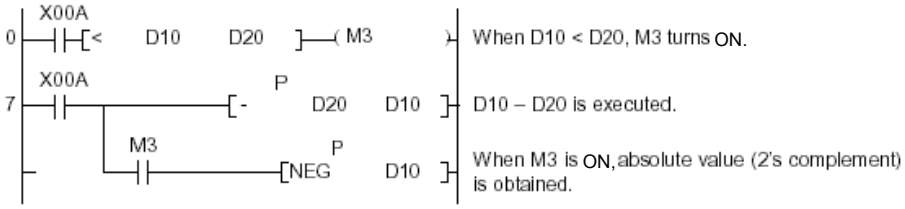
◆Execution condition



◆Program example

NEG

• Program that calculates D10 to D20 when XA is turned ON, and calculates the absolute value when this result is negative.

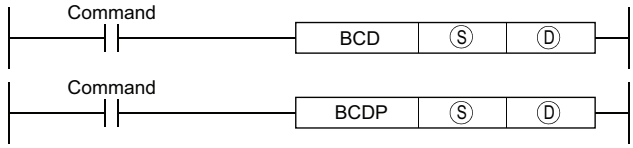


• Coding

```
 0  LD      X00A
 1  AND<    D10     D20
 6  OUT     M3
 7  LD      X00A
 8  -P      D20     D10
13  AND     M3
14  NEGP    D10
17  END
```

3.26.10 Data conversion instructions: BIN 16-bit data BCD conversions ... BCD, BCDP

		Applicable device									Digit specification	Error flag
		Bit device			Word (16-bit) device			Constant		Level		
		X	Y	M	T	C	D	K	H	N		(SM0)
BCD BCDP	Ⓢ	○	○	○	○	○	○	○	○		K1 to K4	○
	Ⓓ	○	○	○	○	○	○					



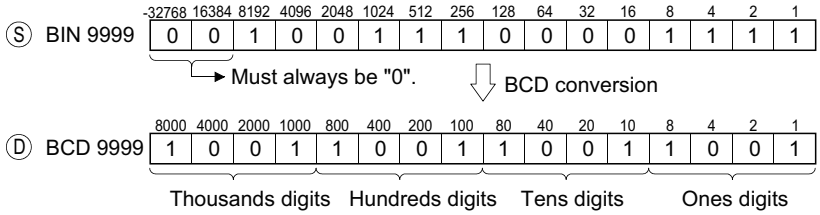
Setting data

Ⓢ	BIN data or start number of the devices where the BIN data is stored (BIN 16 bits)
Ⓓ	Start number of the devices where BCD data will be stored (BCD 4 digits)

◆Function

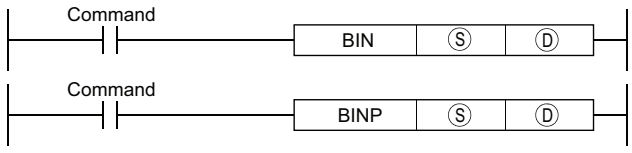
BCD

- Converts BIN data (0 to 9999) at the device designated by Ⓢ to BCD data, and stores it at the device designated by Ⓓ.



3.26.11 Data conversion instructions: BIN 16-bit data BIN conversions ... BIN, BINP

		Applicable device									Digit specification	Error flag
		Bit device			Word (16-bit) device			Constant		Level		
		X	Y	M	T	C	D	K	H	N		(SM0)
BIN BINP	Ⓢ	○	○	○	○	○	○	○	○		K1 to K4	○
	Ⓓ	○	○	○	○	○	○					



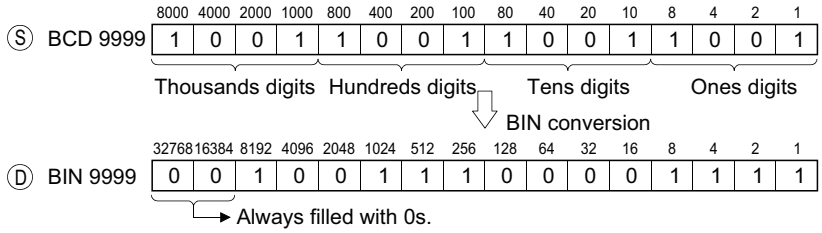
Setting data

Ⓢ	BCD data or start number of the devices where the BCD data is stored (BCD 4 digits)
Ⓓ	Start number of the devices where BIN data will be stored (BIN 16 bits)

◆Function

BIN

• Converts BCD data (0 to 9999) at device designated by Ⓢ to BIN data, and stores at the device designated by Ⓓ.



3.27 Basic instruction (32-bit)

The basic instruction (32-bit) is an instruction that can handle numeric data that is expressed in 32 bits.

3.27.1 Comparison operation instruction

- Comparison operation instructions execute size comparisons (D=, D>, D< etc.) of two data, and instructs the contact to turn ON when the conditions are met.

- The usage method of comparison operation instructions is the same as the contact instructions of sequence instructions, and is as follows.
  - LD, LDI.....LDD=
  - AND, ANI...ANDD=
  - OR, ORI.....ORD=

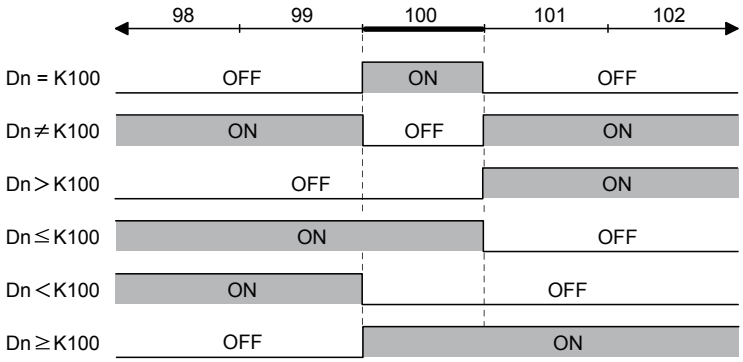
- There are 18 types of comparison operation instruction as shown below.
  For details, refer to page 156.

Classification	Instruction symbol
=	LDD=
	ANDD=
	ORD=
≠	LDD<>
	ANDD<>
	ORD<>

Classification	Instruction symbol
>	LDD>
	ANDD>
	ORD>
≤	LDD<=
	ANDD<=
	ORD<=

Classification	Instruction symbol
<	LDD<
	ANDD<
	ORD<
≥	LDD>=
	ANDD>=
	ORD>=

- The conditions for turning comparison operation instructions ON are as follows.

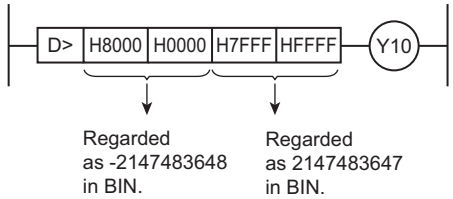


NOTE

- The comparison instruction assumes the specified data as a BIN value for comparison. For this reason, when performing hexadecimal comparison, when the value whose most significant bit (b31) is 1 (8 to F), the BIN value is assumed as a negative number for the comparison.

Example

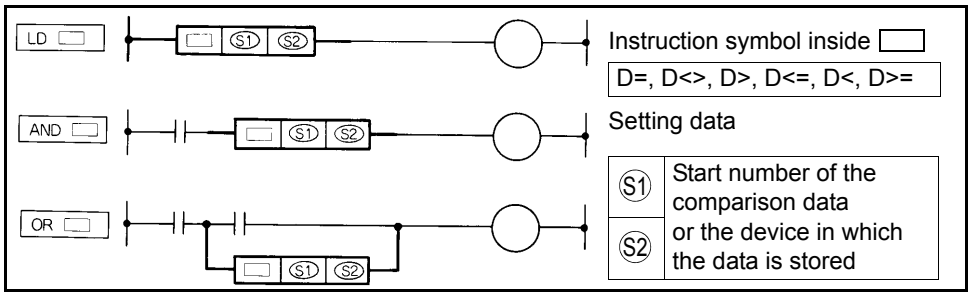
Comparison of HEX/8 digit value



Therefore, -2147483648 < -2147483647, and Y10 does not turn ON.

3.27.2 Comparison operation instruction: 32-bit data comparison ... D=, D<>, D>, D<=, D<, D>=

	Applicable device									Digit specification	Error flag
	Bit device			Word (16-bit) device			Constant		Level		
	X	Y	M	T	C	D	K	H	N		(SM0)
(S1)	○	○	○	○	○	○	○	○		K1 to K8	○
(S2)	○	○	○	○	○	○	○	○			



Instruction symbol inside
D=, D<>, D>, D<=, D<, D>=

Setting data

(S1)	Start number of the comparison data or the device in which the data is stored
(S2)	

◆Function

- 32-bit comparison operation handled as NO contact.
- Comparison operation results are as follows.

Instruction symbol inside	Condition	Comparison operation results
D=	(S1) = (S2)	Conducted
D<>	(S1) ≠ (S2)	
D>	(S1) > (S2)	
D<=	(S1) ≤ (S2)	
D<	(S1) < (S2)	
D>=	(S1) ≥ (S2)	

Instruction symbol inside	Condition	Comparison operation results
D=	(S1) ≠ (S2)	Not conducted
D<>	(S1) = (S2)	
D>	(S1) ≤ (S2)	
D<=	(S1) > (S2)	
D<	(S1) ≥ (S2)	
D>=	(S1) < (S2)	

◆Execution condition

The execution conditions for LD □, AND □ and OR □ are as follows.

Instruction	Execution condition
LD □	Each scan execution
AND □	Executed when the previous contact instruction turns ON.
OR □	Each scan execution

NOTE

- When the digit setting of a bit device is other than K8 and a start bit device value is other than a multiple of 8, the number of steps is 7.

◆Program example

D=

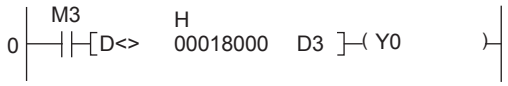
Program that compares the M0 to 31 data with D3 and D4 data.

· Coding

```
 0  LDD=   K8M0     D3
11  OUT    Y0
12  END
```

D<>

Program that compares the BCD value 18000 with D3 and D4 data.

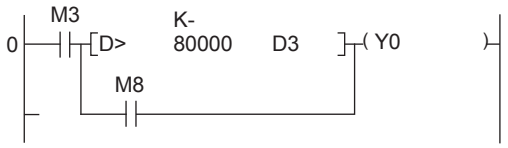


· Coding

```
 0  LD      M3
 1  ANDD<>  H00018000   D3
12  OUT     Y0
13  END
```

D>

Program that compares the BIN value -80000 with D3 and D4 data.

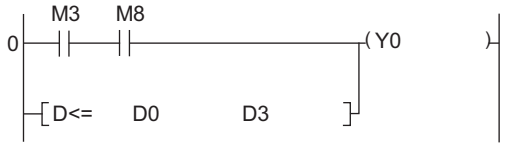


· Coding

```
 0  LD      M3
 1  LDD>    K-80000     D3
12  OR      M8
13  ANB
14  OUT     Y0
15  END
```

D<=

Program that compares D0 and D1 with D3 and D4 data.



· Coding

```
 0  LD      M3
 1  AND     M8
 2  ORD<=   D0      D3
13  OUT     Y0
14  END
```

3.27.3 Arithmetic operation instruction

An arithmetic operation instruction instructs the addition, subtraction, multiplication or division for two BIN data, or operation of increment or decrement.

◆BIN arithmetic operation (binary)

- If the operation result of an addition instruction exceeds 2147483647, the value is negative.
- If the operation result of a subtraction instruction is smaller than -2147483648, the value is positive.
- Operations of positive values and negative values are as follows.

  5 + 8 → 13

  5 - 8 → -3

  5 × 3 → 15

  -5 × 3 → -15

  -5 × (-3) → 15

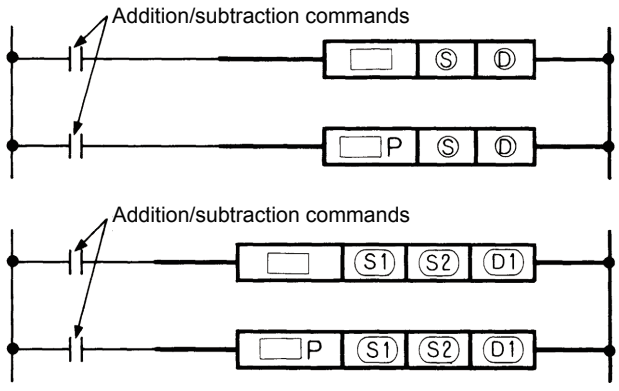
  -5 ÷ 3 → -1 remainder -2

  5 ÷ (-3) → -1 remainder 2

  -5 ÷ (-3) → 1 remainder -2

3.27.4 Arithmetic operation instruction: BIN 32-bit addition/subtraction ... D+, D+P, D-, D-P

	Applicable device									Digit specification	Error flag
	Bit device			Word (16-bit) device			Constant		Level		
	X	Y	M	T	C	D	K	H	N		(SM0)
Ⓢ	○	○	○	○	○	○	○	○		K1 to K8	○
Ⓓ		○	○	○	○	○					
Ⓢ	○	○	○	○	○	○	○	○			
Ⓢ2	○	○	○	○	○	○	○	○			
Ⓢ2		○	○	○	○	○					



Instruction symbol inside ☐

D+, D-

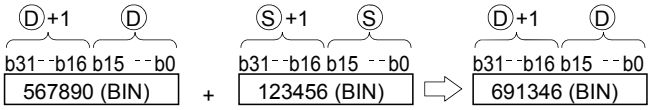
Setting data

Ⓢ	Start number of the addition/ subtraction data or the device in which the addition/subtraction data is stored
Ⓓ	Start number of the device in which the added/subtracted data is stored
Ⓢ1	Start number of the added/subtracted data or the device in which the added/ subtracted data is stored
Ⓢ2	Start number of the addition/ subtraction data or the device in which the addition/subtraction data is stored
Ⓓ1	Start number of the device in which the addition/subtraction results are stored

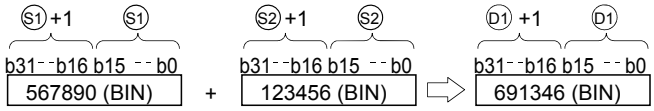
◆Function

D+

- Executes addition of the BIN data specified with Ⓓ and BIN data specified with Ⓢ, and stores the addition results in the device specified with Ⓓ.



- Executes addition of the BIN data specified with Ⓢ1 and BIN data specified with Ⓢ2, and stores the addition results in the device specified with Ⓓ1.

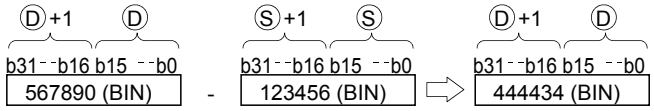


- -2147483648 to 2147483647 (BIN 32-bit) can be specified in Ⓢ, Ⓢ1, Ⓢ2 or Ⓓ.
- Positive/negative judgment of the Ⓢ, Ⓢ1, Ⓢ2 and Ⓓ data is performed by the most significant bit (b31).
  (0: positive, 1: negative)
- The carry flag does not turn ON for the 0-bit underflow. The carry flag does not turn ON for the 31st bit overflow. (There is no carry flag)

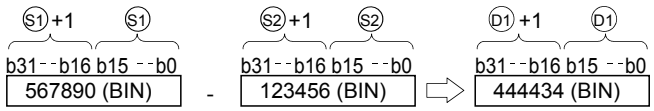
◆Function

D-

- Executes subtraction of the BIN data specified with Ⓓ and BIN data specified with Ⓢ, and stores the subtraction results in the device specified with Ⓓ.



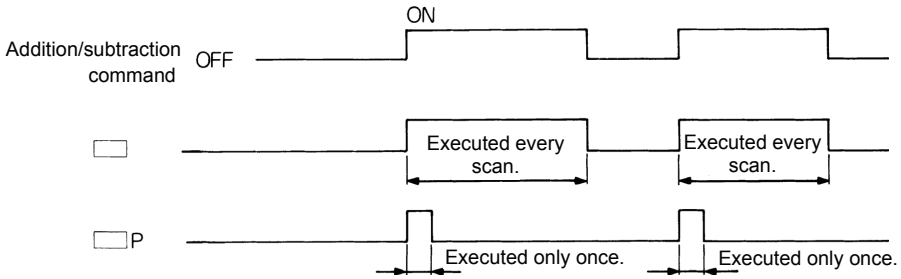
- Executes subtraction of the BIN data specified with Ⓢ1 and BIN data specified with Ⓢ2, and stores the subtraction results in the device specified with Ⓓ1.



- -2147483648 to 2147483647 (BIN 32-bit) can be specified in Ⓢ, Ⓢ1, Ⓢ2 or Ⓓ.
- Positive/negative judgment of the Ⓢ, Ⓢ1, Ⓢ2 and Ⓓ data is performed by the most significant bit (b31).
  (0: positive, 1: negative)
- The carry flag does not turn ON for the 0-bit underflow. The carry flag does not turn ON for the 31st bit overflow. (There is no carry flag)

◆Execution condition

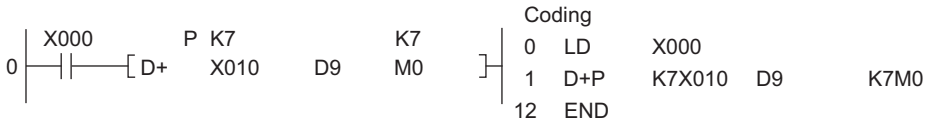
Addition/subtraction instruction



◆Program example

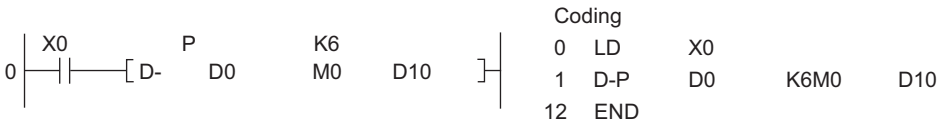
D+

Program that adds the X10 to X2B 28-bit data to the D9 and D10 data when X0 turns ON, and outputs the results to M0 to M27.



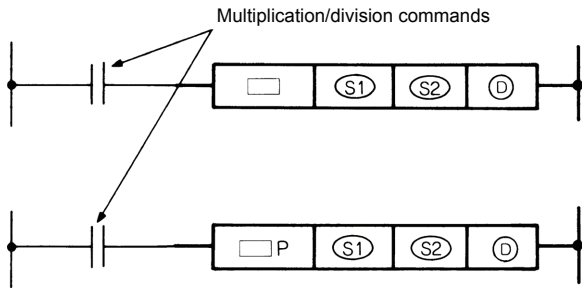
D-

Program that subtracts the M0 to M23 data from the D0 and D1 data when X0 turns ON, and stores the results in D10 and D11.



3.27.5 Arithmetic operation instruction: BIN 32-bit multiplication/division ... D*, D*P, D/, D/P

	Applicable device									Digit specification	Error flag
	Bit device			Word (16-bit) device			Constant		Level		
	X	Y	M	T	C	D	K	H	N		(SM0)
(S1)	○	○	○	○	○	○	○	○		K1 to K8	○
(S2)	○	○	○	○	○	○	○	○			
(D)		○	○	○	○	○					



Instruction symbol inside

D*, D/

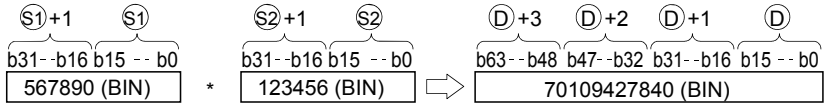
Setting data

(S1)	Start number of the multiplied/divided data or the device in which the multiplied/divided data is stored
(S2)	Start number of the multiplication/division data or the device in which the multiplication/division data is stored
(D)	Start number of the device in which the multiplication/division results are stored

◆Function

D*

- Executes multiplication of the BIN data specified with (S1) and BIN data specified with (S2), and stores the results in the device specified with (D)



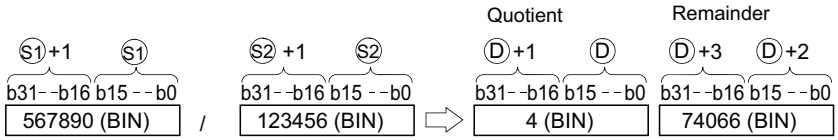
- When (D) is a bit device, specify from the lower bits.
  Example
  K1: Lower 4 bits (b0 to 3)
  K4: Lower 16 bits (b0 to 15)
  K8: Lower 32 bits (b0 to 31)

- -2147483648 to 2147483647 (BIN 32-bit) can be specified in (S1) or (S2).

- Positive/negative judgment of the data is performed by the most significant bit (b31) for (S1) and (S2), and (b63) for (D). (0: positive, 1: negative)

D/

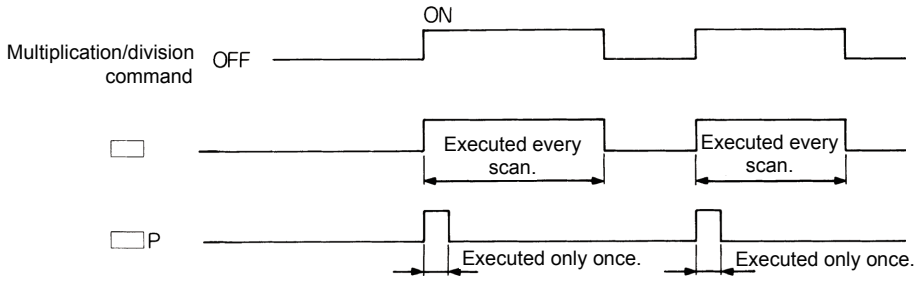
- Executes division of the BIN data specified with (S1) and BIN data specified with (S2), and stores the results in the device specified with (D).



- The division results are stored as the quotient and remainder using 64 bits for a word device, or stored as only the quotient using 32 bits for a bit device.
  Quotient: Stored in the lower 32 bits.
  Remainder: Stored in the upper 32 bits. (Only stored for word devices.)
- -2147483648 to 2147483647 (BIN 32-bit) can be specified in (S1) or (S2).
- Positive/negative judgment of the (S1), (S2), (D) and (D)+2 data is performed by the most significant bit (b31).
  (Both quotient and remainder have a sign.)
  (0: positive, 1: negative)

◆Execution condition

The execution conditions for multiplication/division instructions are as follows.



◆Operation error

An operation error occurs in the following cases, and the error flag turns ON.

- When A1 or V is specified in Ⓢ1 or Ⓢ2, or A0, A1, Z or V are specified in Ⓓ.
- When the divisor Ⓢ2 is 0.

◆Program example

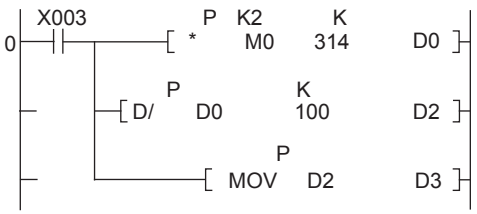
D*

Program that stores the results of multiplying D7 and D8 BIN data with D18 and D19 BIN data in D1 to D4 when X5 turns ON.

```
Coding
 0   LD     X005
 1   D*P    D7      D18     D1
12   END
```

D/

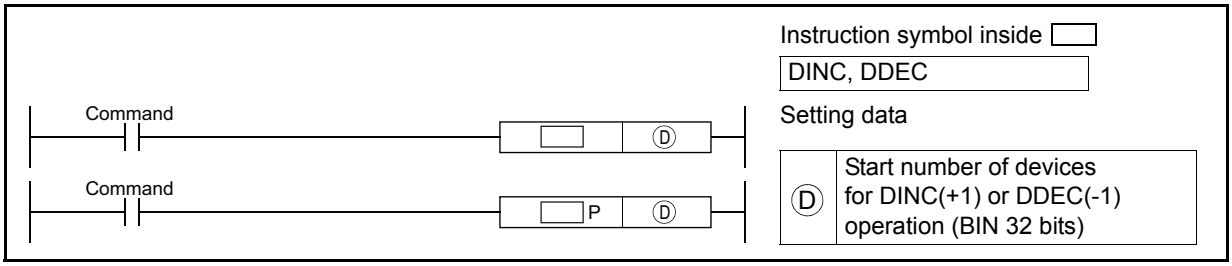
Program that outputs the result of multiplying M0 to 7 by 3.14 to D3 when X3 turns ON.




```
Coding
 0   LD     X003
 1   *P     K2M0    K314    D0
 8   D/P    D0              K100    D2
19   MOVP   D2      D3
24   END
```

3.27.6 Arithmetic operation instruction: BIN 32-bit data increment/decrement ... DINC, DINCP, DDEC, DDECP

		Applicable device									Digit specification	Error flag
		Bit device			Word (16-bit) device			Constant		Level		
		X	Y	M	T	C	D	K	H	N		(SM0)
DINC, DINCP, DDEC, DDECP	(D)	○	○	○	○	○	○				K1 to K4	○



◆Function

DINC

- Adds 1 to the device designated by (D) (32-bit data).

- When DINC/DINCP operation is executed for the device designated by (D), whose content is 2147483647, the value -2147483648 is stored at the device designated by (D).

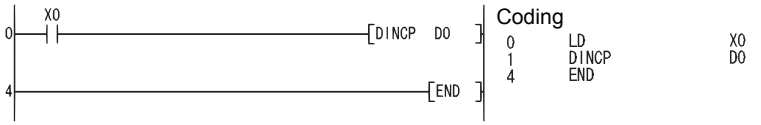
DDEC

- Subtracts -1 from the device designated by (D) (32-bit data).

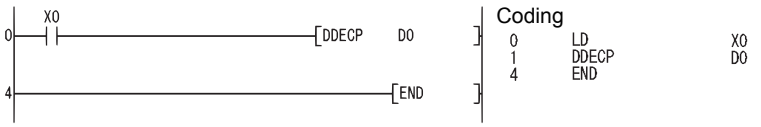
- When DDEC/DDECP operation is executed for the device designated by (D), whose content is 0, the value -1 is stored at the device designated by (D).

◆Program example

- The following program adds 1 to the data at D0 and D1 when X0 is ON.



- The following program subtracts 1 from the data at D0 and D1 when X0 goes ON.

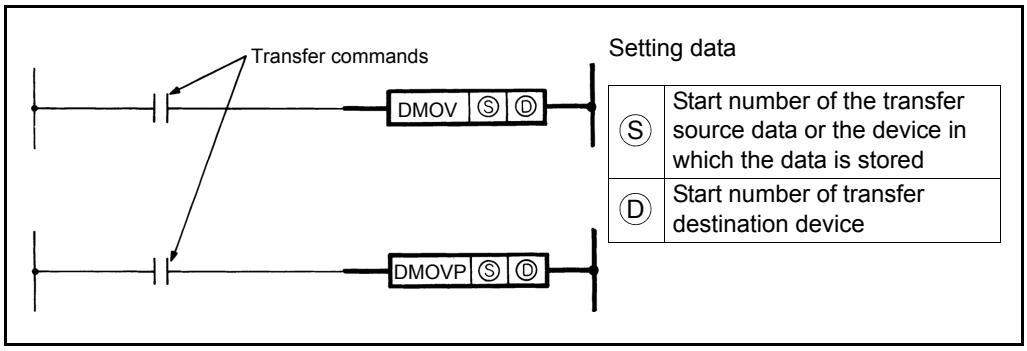


3.27.7 Data transfer instruction

The data transfer instruction is an instruction that executes the transfer of data.
Data transferred by the data transfer instruction is retained until new data is transferred.

3.27.8 Data transfer instruction: 32-bit data transfer ... DMOV, DMOVP

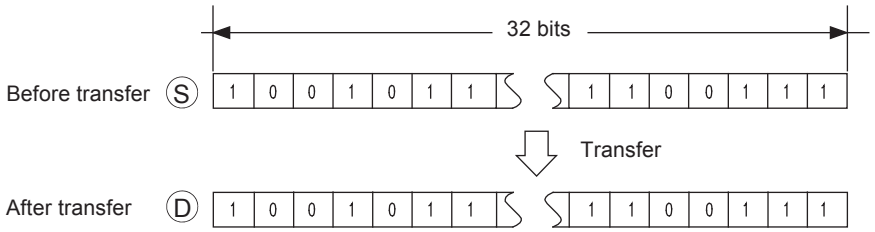
		Applicable device									Digit specification	Error flag
		Bit device			Word (16-bit) device			Constant		Level		
		X	Y	M	T	C	D	K	H	N		(SM0)
DMOV, DMOVP	(S)	○	○	○	○	○	○	○	○		K1 to K8	○
	(D)		○	○	○	○	○					


Transfer commands
DMOV Ⓢ Ⓓ
DMOVP Ⓢ Ⓓ
Setting data
Ⓢ Start number of the transfer source data or the device in which the data is stored
Ⓓ Start number of transfer destination device

◆Function

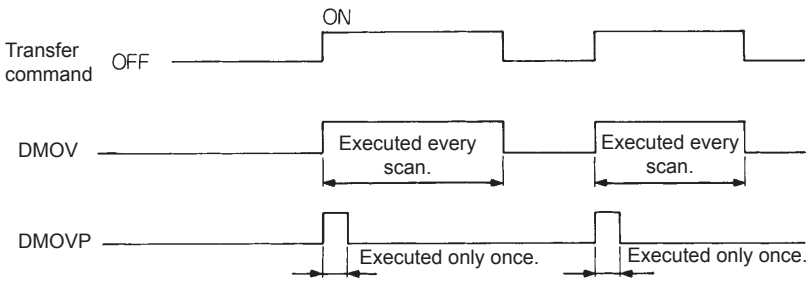
DMOV

32-bit data from the device specified with (S) is transferred to the device specified with (D).



◆Execution condition

The execution conditions for transfer instructions are as follows.

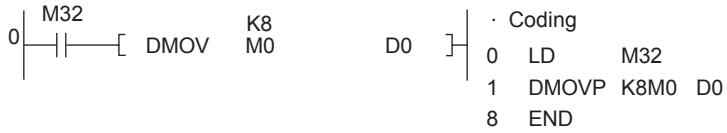


◆Program example

DMOV

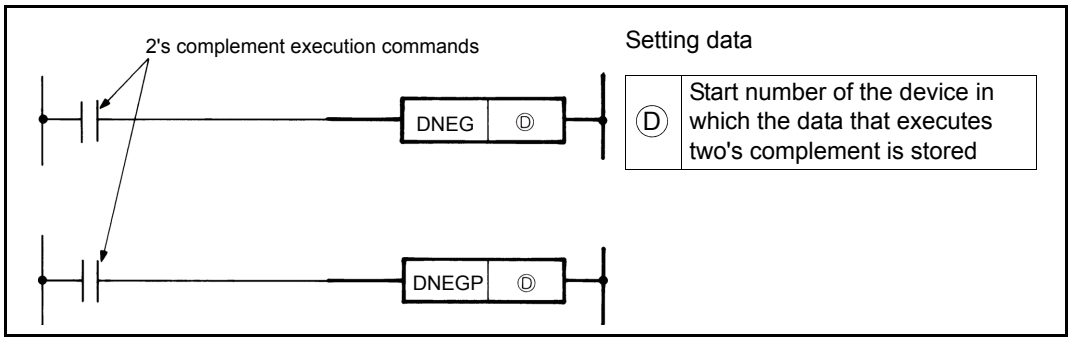
• Program that stores the input D2 to D3 data in D0 and D1.

• Program that stores M0 to M31 data in D0 and D1.



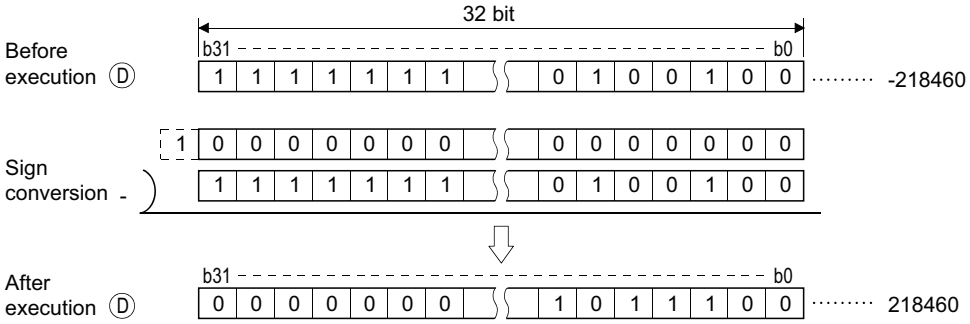
3.27.9 Data conversion instruction: 2's complements of BIN 32-bit data ... DNEG, DNEGP

		Applicable device									Digit specification	Error flag
		Bit device			Word (16-bit) device			Constant		Level		
		X	Y	M	T	C	D	K	H	N		(SM0)
DNEG(P)	Ⓓ		○	○	○	○	○	○	○		K1 to K8	○


2's complement execution commands
DNEG Ⓓ
DNEGP Ⓓ
Setting data
Ⓓ
Start number of the device in which the data that executes two's complement is stored

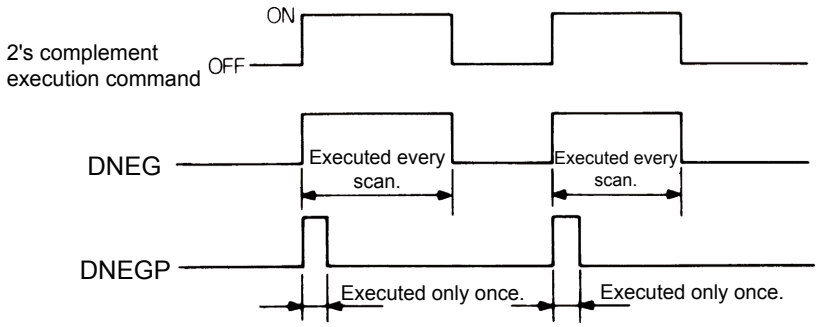
◆Function

- Invert the sign of the 32-bit device specified with Ⓓ, and store the device specified with Ⓓ.



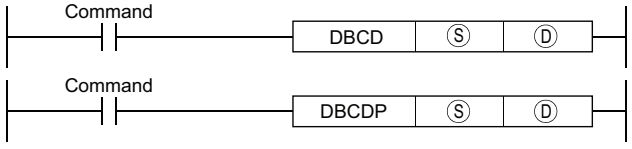
- This is used when inverting the positive/negative signs.

◆Execution condition



3.27.10 Data conversion instructions: BIN 32-bit data BCD conversions ... DBCD, DBCDP

		Applicable device									Digit specification	Error flag
		Bit device			Word (16-bit) device			Constant		Level		
		X	Y	M	T	C	D	K	H	N		(SM0)
DBCD DBCDP	Ⓢ	○	○	○	○	○	○	○	○		K1 to K8	○
	Ⓓ	○	○	○	○	○	○					



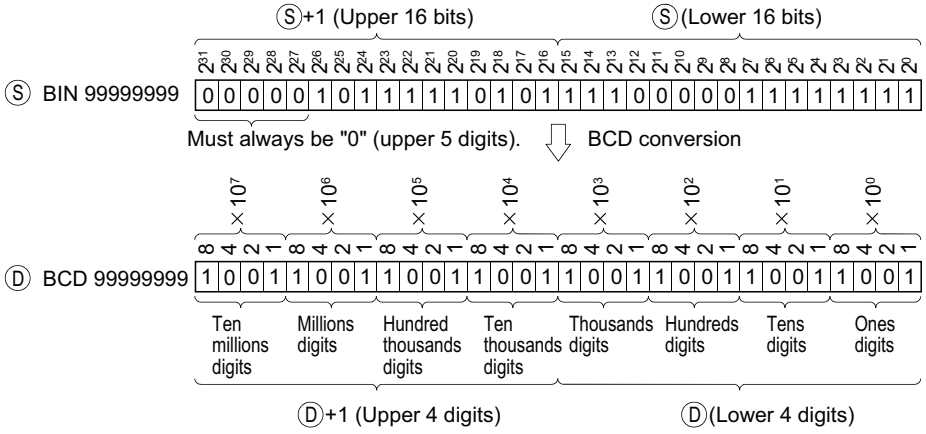
Setting data

Ⓢ	BIN data or start number of the devices where the BIN data is stored (BIN 32 bits)
Ⓓ	Start number of the devices where BCD data will be stored (BCD 8 digits)

◆Function

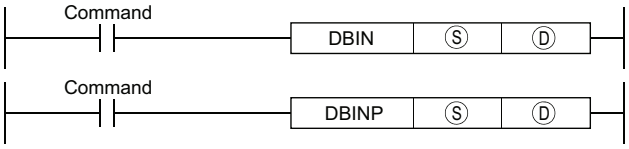
DBCD

- Converts BIN data (0 to 99999999) at the device designated by Ⓢ to BCD data, and stores it at the device designated by Ⓓ.



3.27.11 Data conversion instructions: BIN 32-bit data BIN conversions ... DBIN, DBINP

		Applicable device									Digit specification	Error flag
		Bit device			Word (16-bit) device			Constant		Level		
		X	Y	M	T	C	D	K	H	N		(SM0)
DBIN DBINP	Ⓢ	○	○	○	○	○	○	○	○		K1 to K8	○
	Ⓓ	○	○	○	○	○	○					



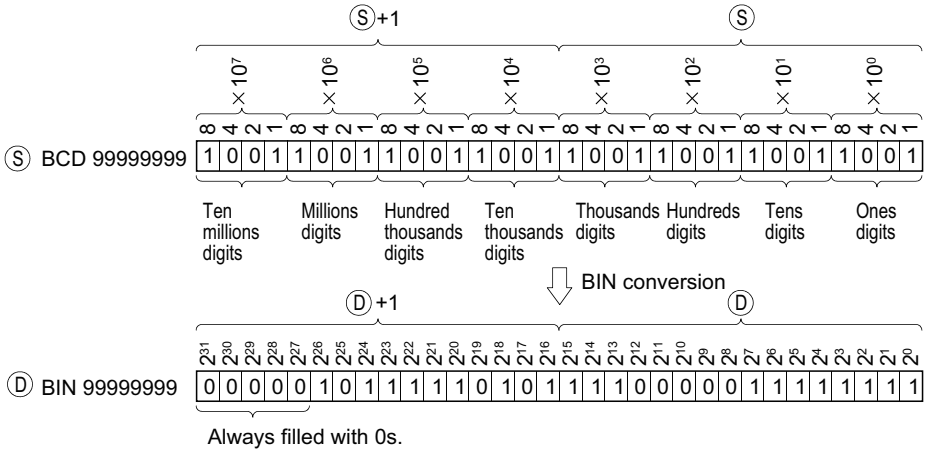
Setting data

Ⓢ	BCD data or start number of the devices where the BCD data is stored (BCD 8 digits)
Ⓓ	Start number of the devices where BIN data will be stored (BIN 32 bits)

◆Function

DBIN

- Converts BCD data (0 to 99999999) at the device designated by Ⓢ to BIN data, and stores at the device designated by Ⓓ.



3.28 Application instructions (16-bit)

Application instructions (16-bit) are used when special processing is required.

3.28.1 Logical operation instructions

- Logical operation instructions are instructions that execute logical operations such as logical OR or logical AND.

- There are 10 types of logical operation instruction as shown below.

Classification	Instruction symbol
Logical AND	WAND
	WANDP
Logical OR	WOR
	WORP

Classification	Instruction symbol
Exclusive OR	WXOR
	WXORP
Exclusive NOR	WXNR
	WXNRP

Classification	Instruction symbol
2's complement (code reversed)	NEG
	NEGP

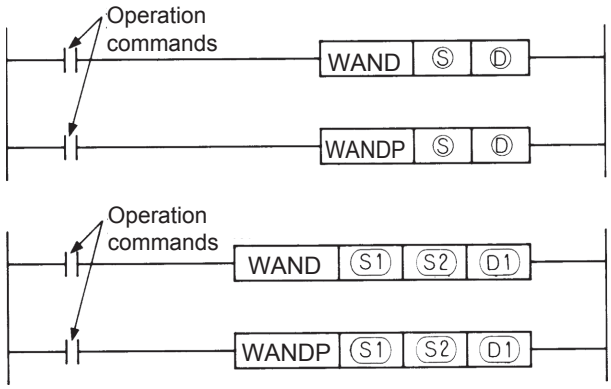
NOTE

- Logical operation instructions execute the following processes in increments of bits.

Classification	Process	Formula	Example		
			A	B	Y
Logical AND	Set 1 when the inputs of both A and B are 1. Set 0 in all other cases.	$Y = A \cdot B$	0	0	0
			0	1	0
			1	0	0
			1	1	1
Logical OR	Set 0 when the inputs of both A and B are 0. Set 1 in all other cases.	$Y = A + B$	0	0	0
			0	1	1
			1	0	1
			1	1	1
Exclusive OR	Set 0 when the inputs of both A and B are equal. Set 1 when they are different.	$Y = \overline{A} \cdot B + A \cdot \overline{B}$	0	0	0
			0	1	1
			1	0	1
			1	1	0
Exclusive NOR	Set 1 when the inputs of both A and B are equal. Set 0 when they are different.	$Y = (\overline{A} + B)(A + \overline{B})$	0	0	1
			0	1	0
			1	0	0
			1	1	1

3.28.2 Logical operation instruction: BIN 16-bit logical AND ... WAND, WANDP

		Applicable device									Digit specification	Error flag
		Bit device			Word (16-bit) device			Constant		Level		
		X	Y	M	T	C	D	K	H	N		(SM0)
WAND	Ⓢ	○	○	○	○	○	○	○	○		K1 to K4	○
	Ⓓ		○	○	○	○	○					
	Ⓢ1	○	○	○	○	○	○	○	○			
	Ⓢ2	○	○	○	○	○	○	○	○			
	Ⓓ1		○	○	○	○	○					



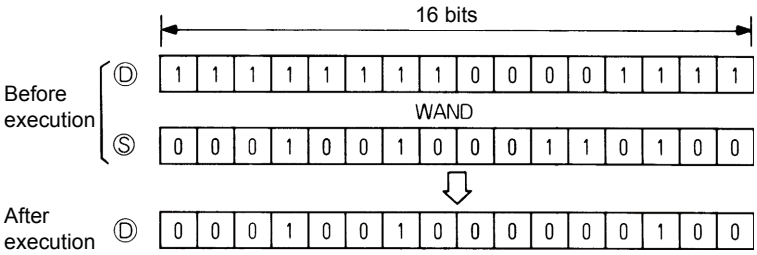
Setting data

Ⓢ	Start number of the data that executes the logical AND or the device in which the data is stored
Ⓢ1	
Ⓢ2	
Ⓓ	
Ⓓ1	Start number of the device in which the logical AND results are stored

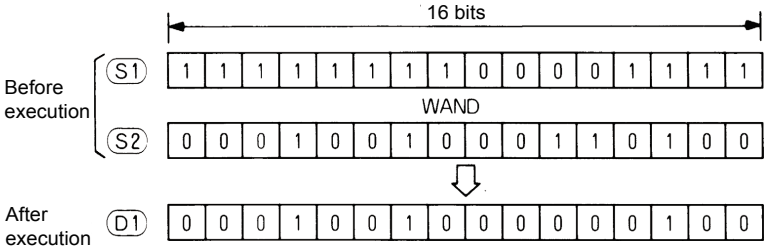
◆Function

WAND

- Logical AND is executed for each bit of the 16-bit data of the device specified with Ⓓ and 16-bit data of the device specified with Ⓢ, and the results are stored in the device specified with Ⓓ.



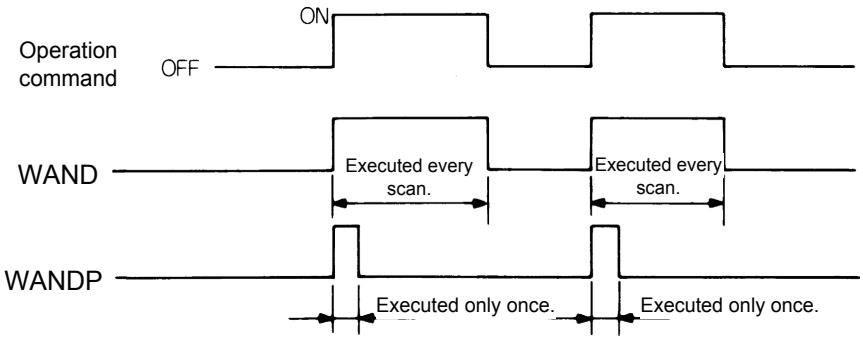
- Logical AND is executed for each bit of the 16-bit data of the device specified with Ⓢ1 and 16-bit data of the device specified with Ⓢ2, and the results are stored in the device specified with Ⓓ1.



- Bits of the bit device higher than the specified digit are operated as 0.

◆Execution condition

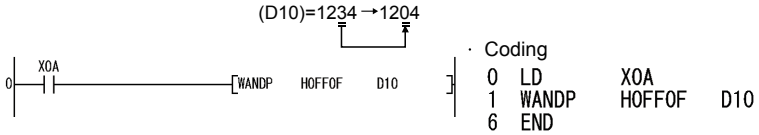
The execution conditions for logical AND instructions are as follows.



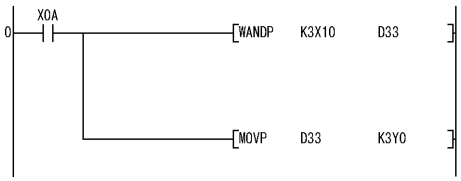
◆Program example

WAND

- Program that masks the tenth digit (the second digit from the bottom) of the BCD 4 digits when XA turns ON.



• Program that executes logical AND for X10 to 1B data and D33 data when XA turns ON, and outputs the results to Y0 to B.

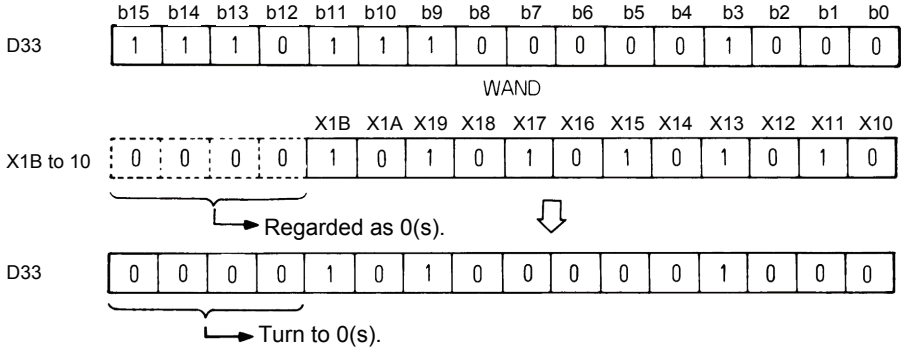


ANDs X10-1B data and D33 data and stores result to D33.

Outputs D33 data to Y0-F.

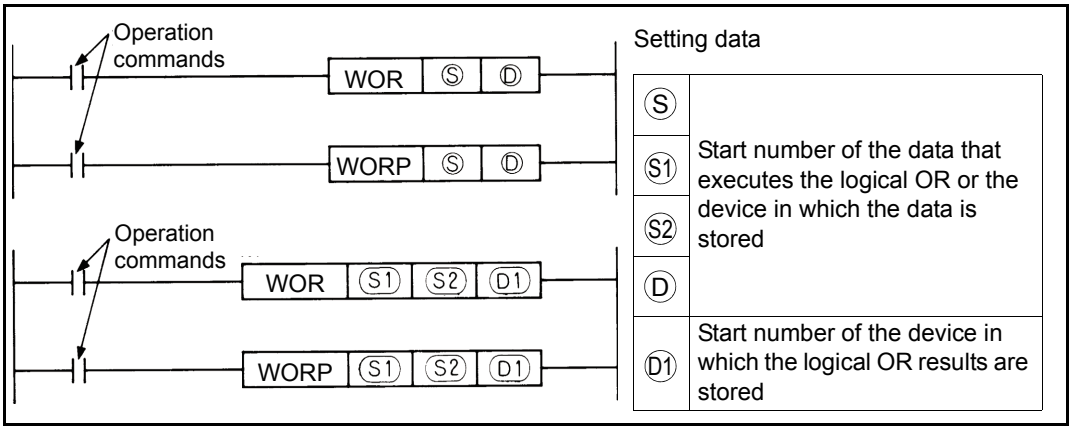
· Coding

```
 0  LD      X0A
 1  WANDP   K3X10   D33
 6  MOVP    D33     K3Y0
11  END
```



3.28.3 Logical operation instruction: BIN 16-bit logical OR ... WOR, WORP

		Applicable device									Digit specification	Error flag
		Bit device			Word (16-bit) device			Constant		Level		
		X	Y	M	T	C	D	K	H	N		(SM0)
WOR	Ⓢ	○	○	○	○	○	○	○	○		K1 to K4	○
	Ⓓ		○	○	○	○	○					
	Ⓢ1	○	○	○	○	○	○	○	○			
	Ⓢ2	○	○	○	○	○	○	○	○			
	Ⓓ1		○	○	○	○	○					



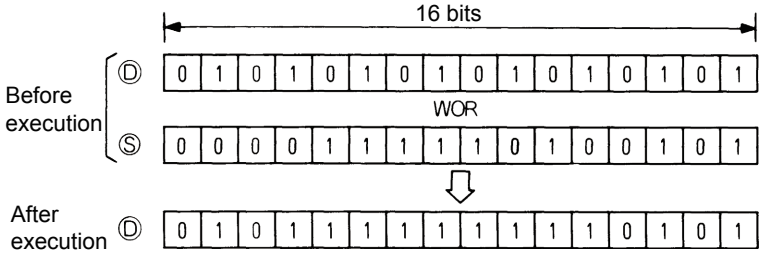
Setting data

Ⓢ	
Ⓢ1	Start number of the data that executes the logical OR or the device in which the data is stored
Ⓢ2	
Ⓓ	
Ⓓ1	Start number of the device in which the logical OR results are stored

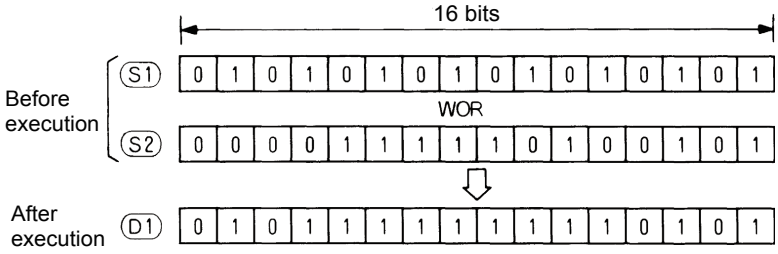
◆Function

WOR

- Logical OR is executed for each bit of the 16-bit data of the device specified with Ⓓ and 16-bit data of the device specified with Ⓢ, and the results are stored in the device specified with Ⓓ.



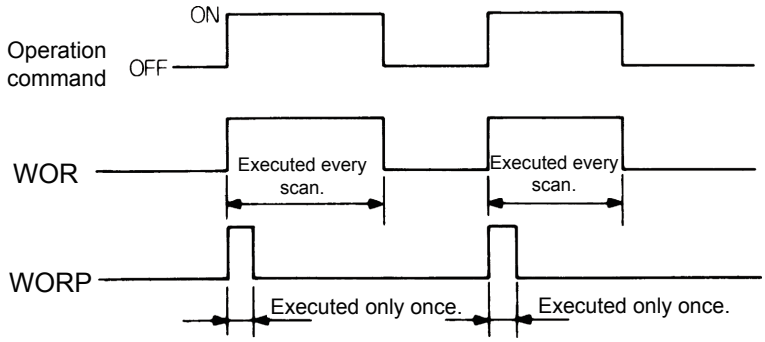
- Logical OR is executed for each bit of the 16-bit data of the device specified with Ⓢ1 and 16-bit data of the device specified with Ⓢ2, and the results are stored in the device specified with Ⓓ1.



- Bits of the bit device higher than the specified digit are operated as 0.

◆Execution condition

• The execution conditions for logical OR instructions are as follows.

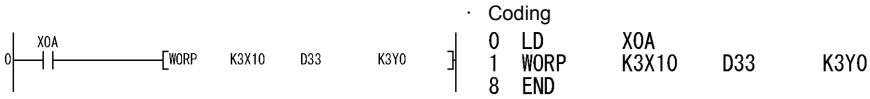


◆Program example

WOR

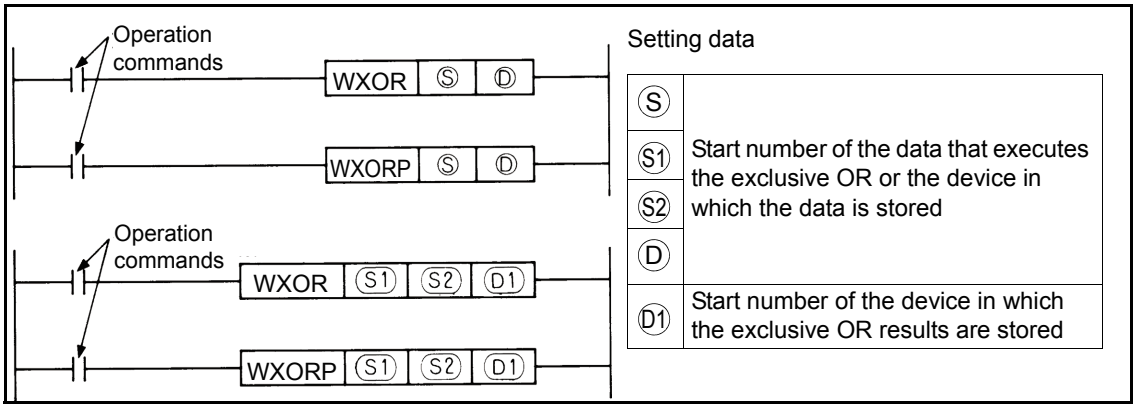
• Program that executes logical OR for D10 and D20 data when XA turns ON, and stores the results in D10.

• Program that executes logical OR for X10 to 1B data and D33 data when XA turns ON, and outputs the results to Y0 to B.



3.28.4 Logical operation instruction: BIN 16-bit data exclusive OR ... WXOR, WXORP

		Applicable device									Digit specification	Error flag
		Bit device			Word (16-bit) device			Constant		Level		
		X	Y	M	T	C	D	K	H	N		(SM0)
WXOR	(S)	○	○	○	○	○	○	○	○		K1 to K4	○
	(D)		○	○	○	○	○					
	(S1)	○	○	○	○	○	○	○	○			
	(S2)	○	○	○	○	○	○	○	○			
	(D1)		○	○	○	○	○					



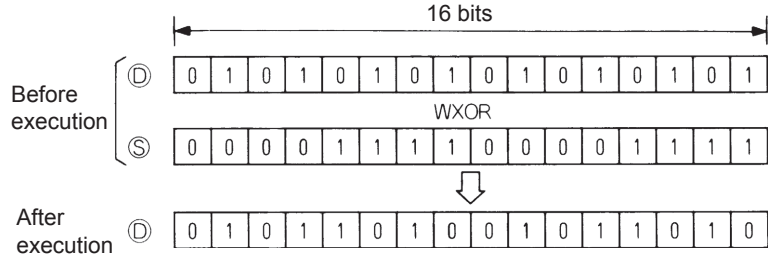
Setting data

(S), (S1), (S2), (D)	Start number of the data that executes the exclusive OR or the device in which the data is stored
(D1)	Start number of the device in which the exclusive OR results are stored

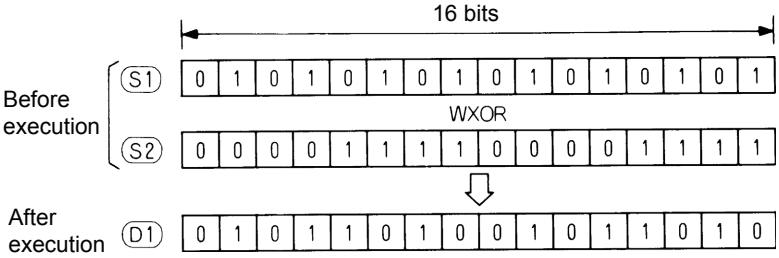
◆Function

WXOR

- Exclusive OR is executed for each bit of the 16-bit data of the device specified with (D) and 16-bit data of the device specified with (S), and the results are stored in the device specified with (D).



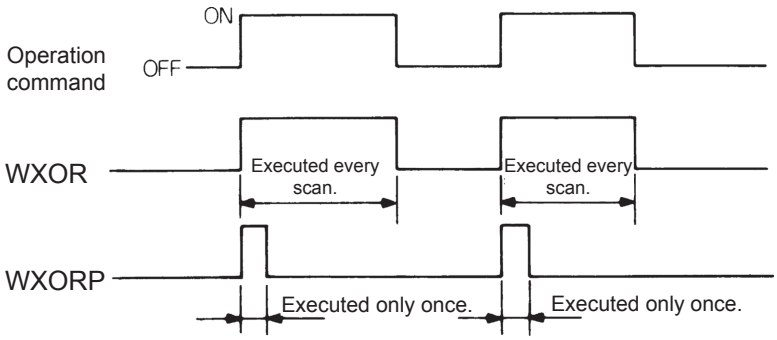
- Exclusive OR is executed for each bit of the 16-bit data of the device specified with (S1) and 16-bit data of the device specified with (S2), and the results are stored in the device specified with (D1).



- Bits of the bit device higher than the specified digit are operated as 0.

◆Execution condition

The execution conditions for exclusive OR instructions are as follows.

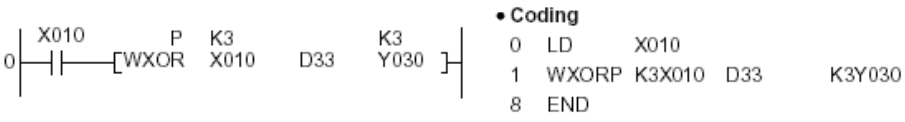


◆Program example

WXOR

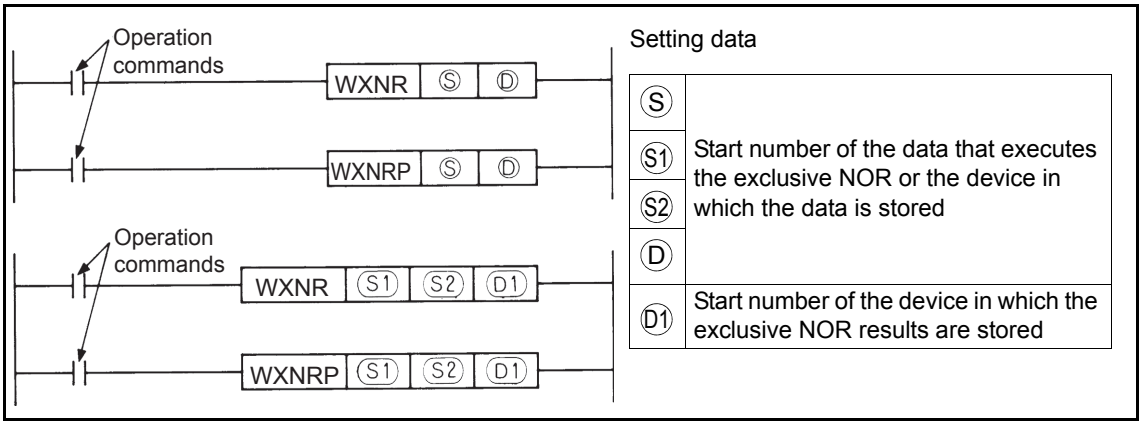
- Program that executes exclusive OR for D10 and D20 data when XA turns ON, and stores the results in D10.

- Program that executes exclusive OR for X10 to 1B data and D33 data when XA turns ON, and outputs the results to Y30 to 3B.



3.28.5 Logical operation instruction: BIN 16-bit data exclusive NOR ... WXNR, WXNRP

		Applicable device									Digit specification	Error flag
		Bit device			Word (16-bit) device			Constant		Level		
		X	Y	M	T	C	D	K	H	N		(SM0)
WXNR	(S)	○	○	○	○	○	○	○	○		K1 to K4	○
	(D)		○	○	○	○	○					
	(S1)	○	○	○	○	○	○	○	○			
	(S2)	○	○	○	○	○	○	○	○			
	(D1)		○	○	○	○	○					



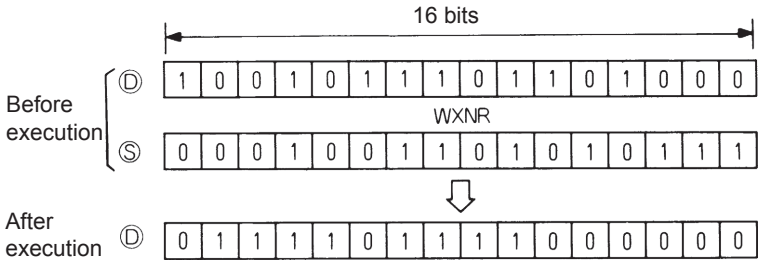
Setting data

(S), (S1), (S2), (D)	Start number of the data that executes the exclusive NOR or the device in which the data is stored
(D1)	Start number of the device in which the exclusive NOR results are stored

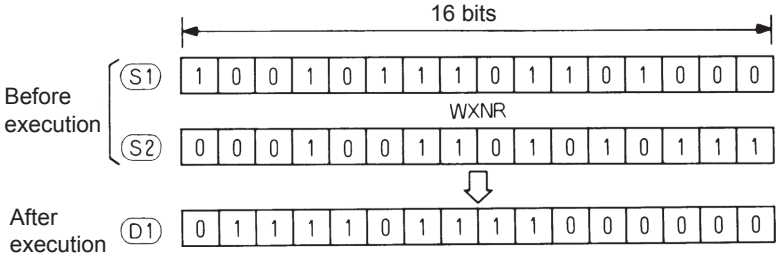
◆Function

WXNR

- Exclusive NOR is executed for the 16-bit data of the device specified with (D) and 16-bit data of the device specified with (S), and the results are stored in the device specified with (D).



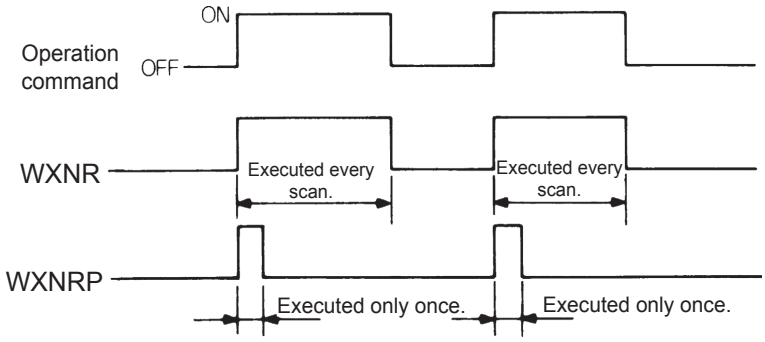
- Exclusive NOR is executed for the 16-bit data of the device specified with (S1) and 16-bit data of the device specified with (S2), and the results are stored in the device specified with (D1).



- Bits of the bit device higher than the specified digit are operated as 0.

◆Execution condition

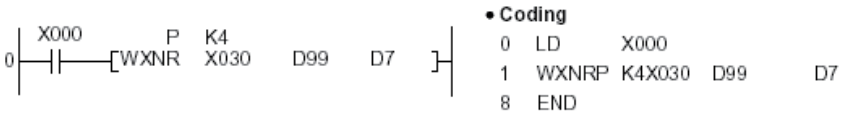
The execution conditions for exclusive NOR instructions are as follows.



◆Program example

WXNR

- Program that executes exclusive NOR for the 16-bit data of X30 to 3F and D99 data when X0 turns ON, and stores the results in D7.



3.29 Application instructions (32-bit)

Application instructions (32-bit) are used when special processing is required.

3.29.1 Logical operation instructions

- Logical operation instructions are instructions that execute logical operations such as logical OR or logical AND.

- There are 10 types of logical operation instruction as shown below.

Classification	Instruction symbol
Logical AND	DAND
	DANDP
Logical OR	DOR
	DORP

Classification	Instruction symbol
Exclusive OR	DXOR
	DXORP
Exclusive NOR	DXNR
	DXNRP

Classification	Instruction symbol
2's complement (code reversed)	DNEG
	DNEGP

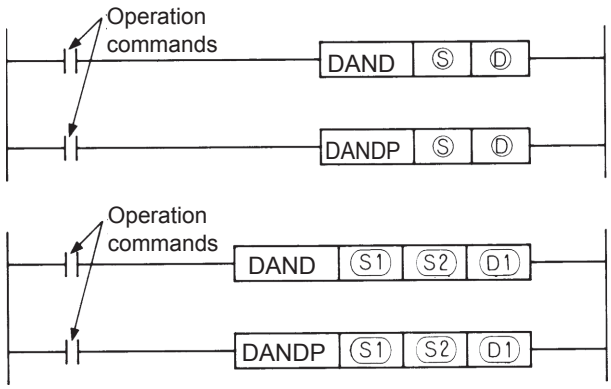
NOTE

- Logical operation instructions execute the following processes in increments of bits.

Classification	Process	Formula	Example		
			A	B	Y
Logical AND	Set 1 when the inputs of both A and B are 1. Set 0 in all other cases.	$Y = A \cdot B$	0	0	0
			0	1	0
			1	0	0
			1	1	1
Logical OR	Set 0 when the inputs of both A and B are 0. Set 1 in all other cases.	$Y = A + B$	0	0	0
			0	1	1
			1	0	1
			1	1	1
Exclusive OR	Set 0 when the inputs of both A and B are equal. Set 1 when they are different.	$Y = \overline{A} \cdot B + A \cdot \overline{B}$	0	0	0
			0	1	1
			1	0	1
			1	1	0
Exclusive NOR	Set 1 when the inputs of both A and B are equal. Set 0 when they are different.	$Y = (\overline{A} + B)(A + \overline{B})$	0	0	1
			0	1	0
			1	0	0
			1	1	1

3.29.2 Logical operation instruction: BIN 32-bit logical AND ... DAND, DANDP

		Applicable device									Digit specification	Error flag
		Bit device			Word (16-bit) device			Constant		Level		
		X	Y	M	T	C	D	K	H	N		(SM0)
DAND (P)	Ⓢ	○	○	○	○	○	○	○	○		K1 to K8	○
	Ⓓ		○	○	○	○	○					
	Ⓢ1	○	○	○	○	○	○	○	○			
	Ⓢ2	○	○	○	○	○	○	○	○			
	Ⓓ1		○	○	○	○	○					



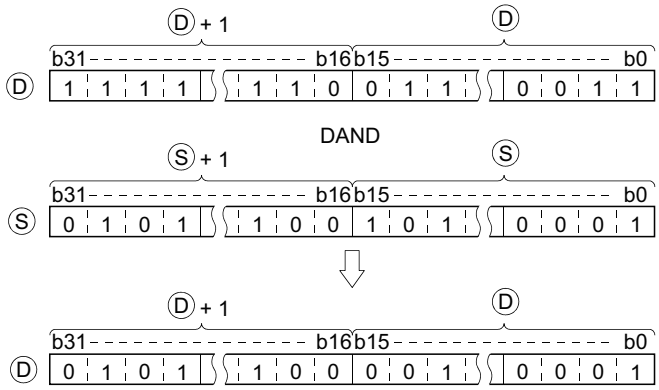
Setting data

Ⓢ	Start number of the data that executes the logical AND or the device in which the data is stored
Ⓢ1	
Ⓢ2	
Ⓓ	
Ⓓ1	Start number of the device in which the logical AND results are stored

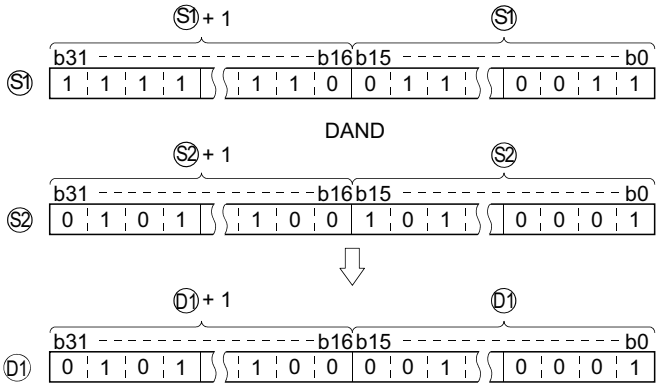
◆Function

DAND

- Logical AND is executed for each bit of the 32-bit data of the device specified with (D) and 32-bit data of the device specified with (S), and the results are stored in the device specified with (D).



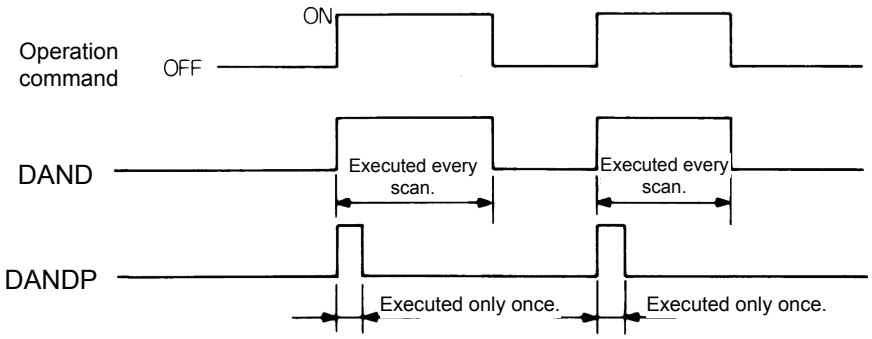
- Logical AND is executed for each bit of the 32-bit data of the device specified with (S1) and 32-bit data of the device specified with (S2), and the results are stored in the device specified with (D1).



- Bits of the bit device higher than the specified digit are operated as 0.

◆Execution condition

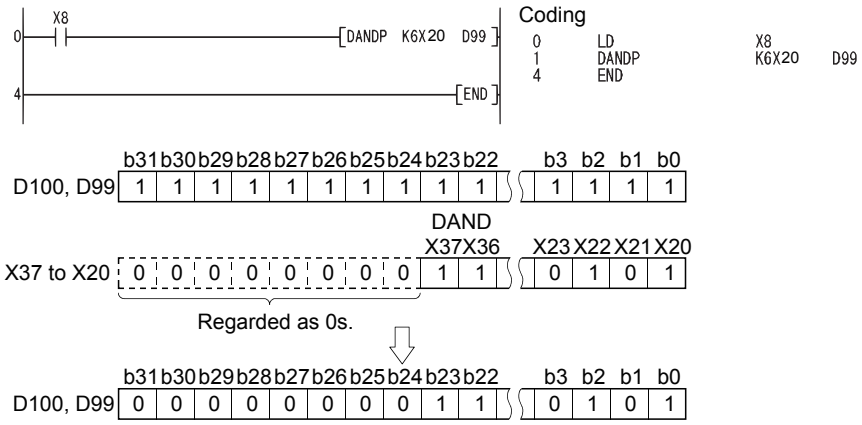
The execution conditions for logical AND instructions are as follows.



◆Program example

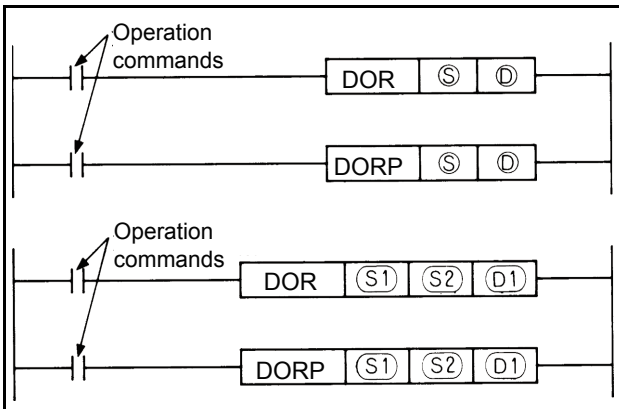
DAND

- The following program performs a logical product operation on the data at D99 and D100, and the 24-bit data between X20 and X37 when X8 is ON, and stores the results at D99 and D100.



3.29.3 Logical operation instruction: BIN 32-bit logical OR ... DOR, DORP

		Applicable device									Digit specification	Error flag
		Bit device			Word (16-bit) device			Constant		Level		
		X	Y	M	T	C	D	K	H	N		(SM0)
DOR (P)	Ⓢ	○	○	○	○	○	○	○	○		K1 to K8	○
	Ⓓ		○	○	○	○	○					
	Ⓢ1	○	○	○	○	○	○	○	○			
	Ⓢ2	○	○	○	○	○	○	○	○			
	Ⓓ1		○	○	○	○	○					



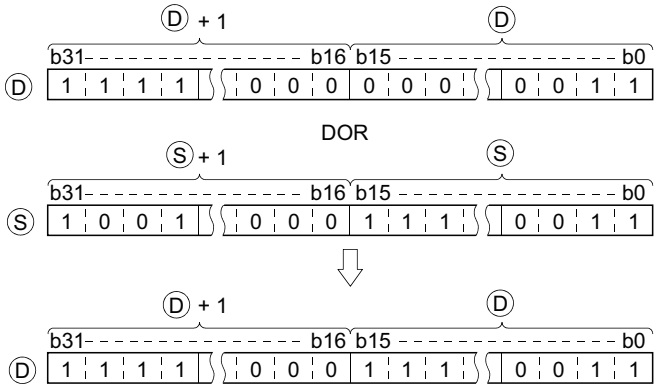
Setting data

Ⓢ	Start number of the data that executes the logical OR or the device in which the data is stored
Ⓢ1	
Ⓢ2	
Ⓓ	
Ⓓ1	Start number of the device in which the logical OR results are stored

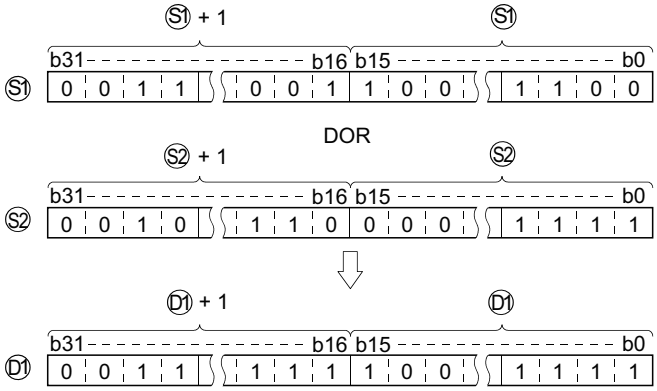
◆Function

DOR

- Logical OR is executed for each bit of the 32-bit data of the device specified with (D) and 32-bit data of the device specified with (S), and the results are stored in the device specified with (D).



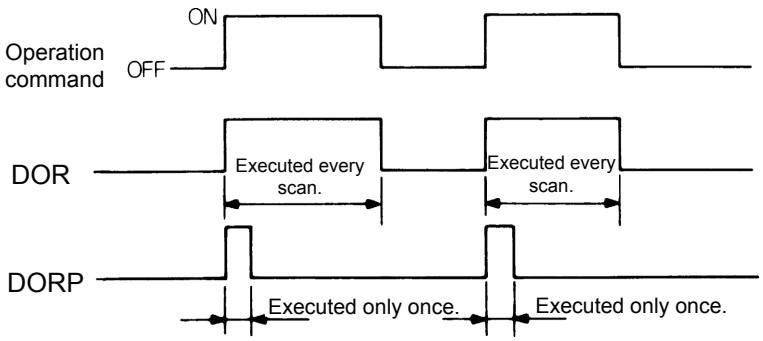
- Logical OR is executed for each bit of the 32-bit data of the device specified with (S1) and 32-bit data of the device specified with (S2), and the results are stored in the device specified with (D1).



- Bits of the bit device higher than the specified digit are operated as 0.

◆Execution condition

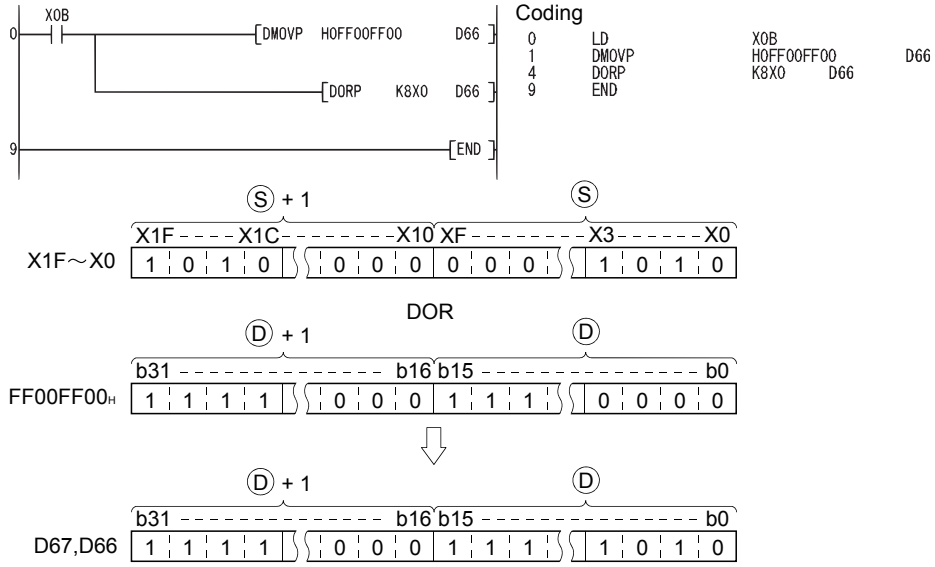
- The execution conditions for logical OR instructions are as follows.



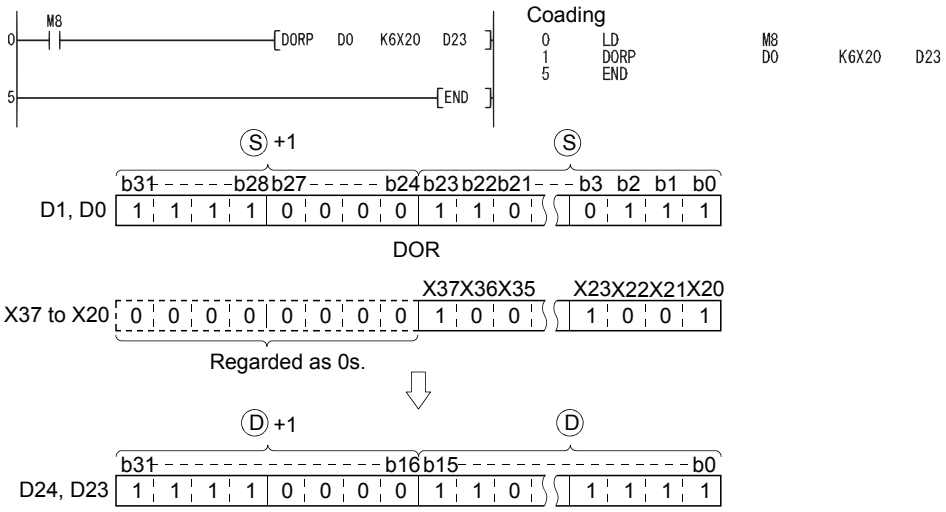
◆Program example

DOR

- The following program performs a logical sum operation on the 32-bit data from X0 to X1F, and on the hexadecimal value FF00FF00H when XB is turned ON, and stores the results at D66 and D67.

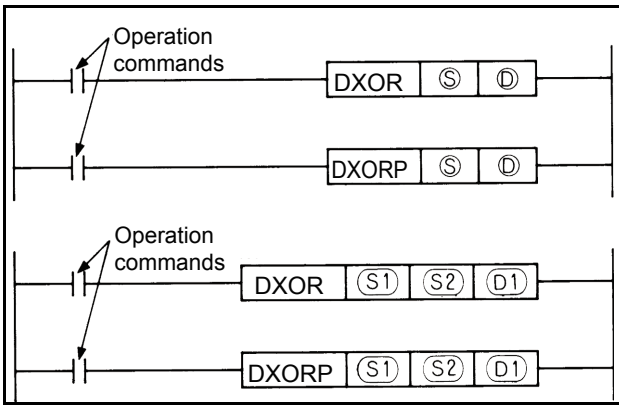


- The following program performs a logical sum operation on the 32-bit data at D0 and D1, and the 24-bit data from X20 to X37, and stores the results at D23 and D24 when M8 is ON.



3.29.4 Logical operation instruction: BIN 32-bit data exclusive OR ... DXOR, DXORP

		Applicable device									Digit specification	Error flag
		Bit device			Word (16-bit) device			Constant		Level		
		X	Y	M	T	C	D	K	H	N		(SM0)
DXOR (P)	Ⓢ	○	○	○	○	○	○	○	○		K1 to K8	○
	Ⓓ		○	○	○	○	○					
	Ⓢ1	○	○	○	○	○	○	○	○			
	Ⓢ2	○	○	○	○	○	○	○	○			
	Ⓓ1		○	○	○	○	○					



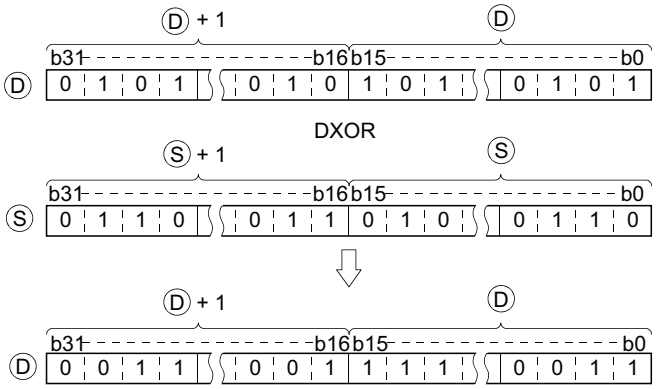
Setting data

Ⓢ	Start number of the data that executes the exclusive OR or the device in which the data is stored
Ⓢ1	
Ⓢ2	
Ⓓ	
Ⓓ1	Start number of the device in which the exclusive OR results are stored

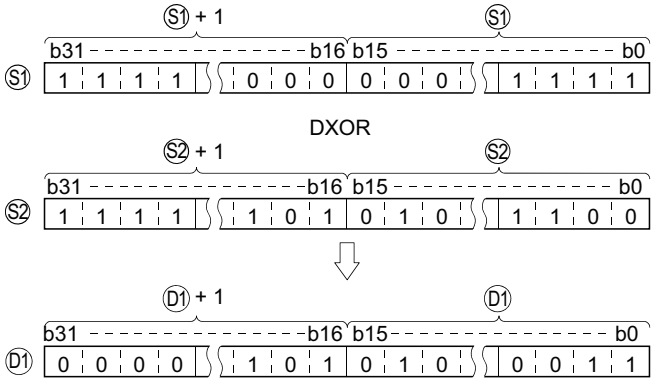
◆Function

DXOR

- Exclusive OR is executed for each bit of the 32-bit data of the device specified with (D) and 32-bit data of the device specified with (S), and the results are stored in the device specified with (D).



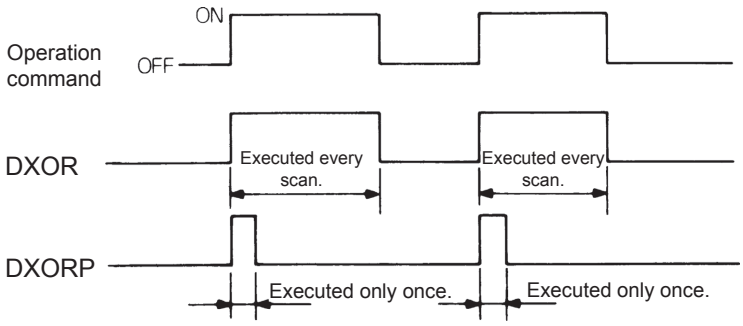
- Exclusive OR is executed for each bit of the 32-bit data of the device specified with (S1) and 32-bit data of the device specified with (S2), and the results are stored in the device specified with (D1).



- Bits of the bit device higher than the specified digit are operated as 0.

◆Execution condition

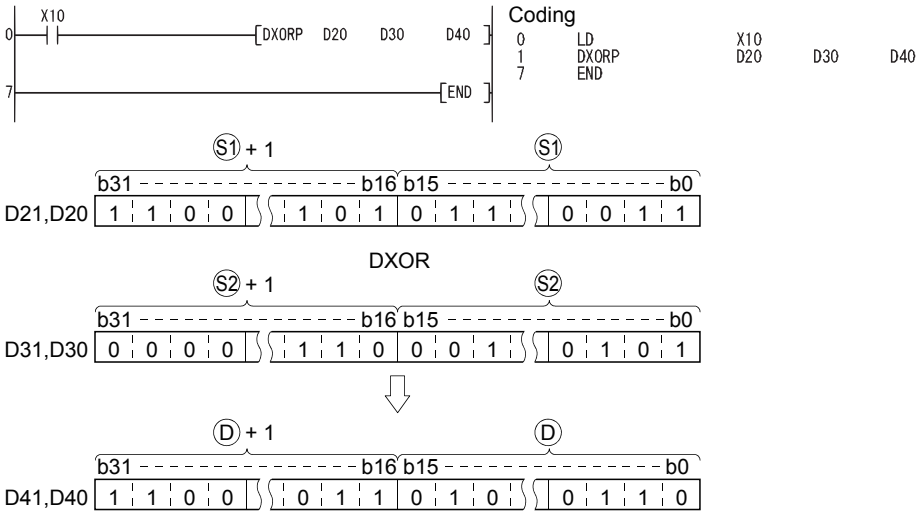
The execution conditions for exclusive OR instructions are as follows.



◆Program example

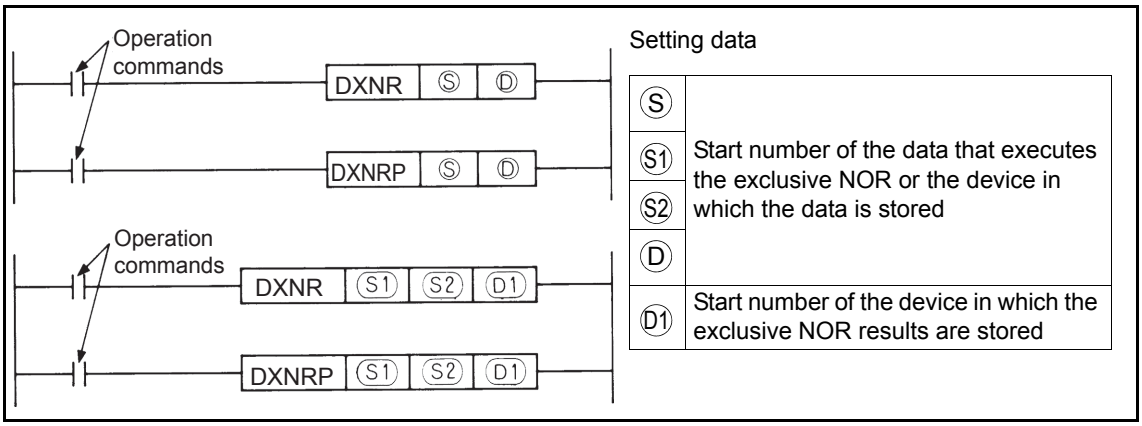
DXOR

- The following program conducts an exclusive OR operation on the data at D20 and D21, and the data at D30 and D31 when X10 is turned ON, and stores the results at D40 and D41.



3.29.5 Logical operation instruction: BIN 32-bit data exclusive NOR ... DXNR, DXNRP

		Applicable device									Digit specification	Error flag
		Bit device			Word (16-bit) device			Constant		Level		
		X	Y	M	T	C	D	K	H	N		(SM0)
DXNR (P)	(S)	○	○	○	○	○	○	○	○		K1 to K8	○
	(D)		○	○	○	○	○					
	(S1)	○	○	○	○	○	○	○	○			
	(S2)	○	○	○	○	○	○	○	○			
	(D1)		○	○	○	○	○					



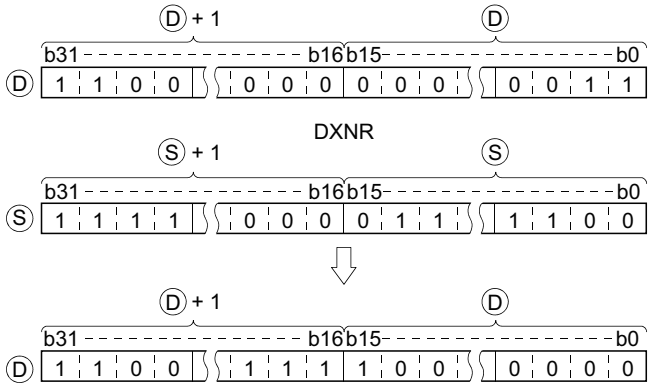
Setting data

(S) (S1) (S2) (D)	Start number of the data that executes the exclusive NOR or the device in which the data is stored
(D1)	Start number of the device in which the exclusive NOR results are stored

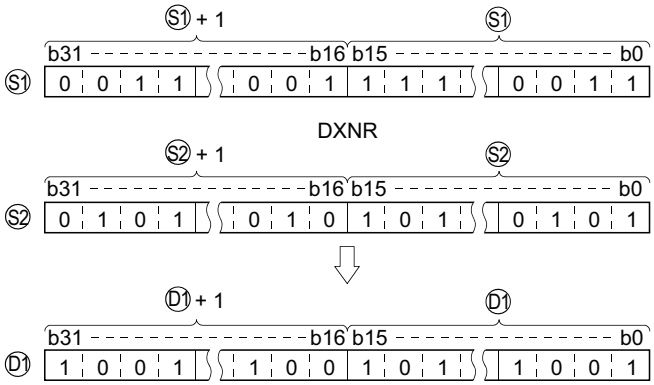
◆Function

DXNR

- Exclusive NOR is executed for the 32-bit data of the device specified with (D) and 32-bit data of the device specified with (S), and the results are stored in the device specified with (D).



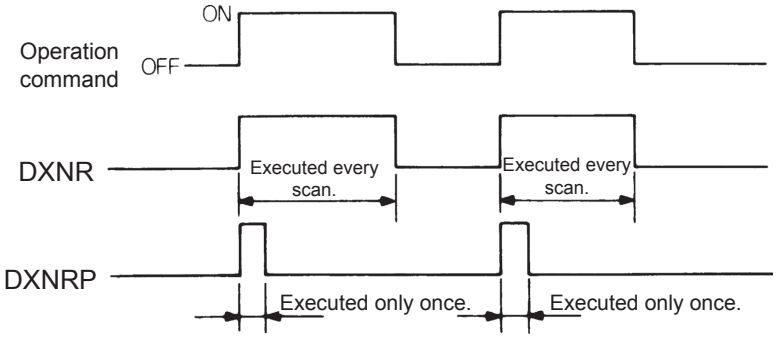
- Exclusive NOR is executed for the 32-bit data of the device specified with (S1) and 32-bit data of the device specified with (S2), and the results are stored in the device specified with (D1).



- Bits of the bit device higher than the specified digit are operated as 0.

◆Execution condition

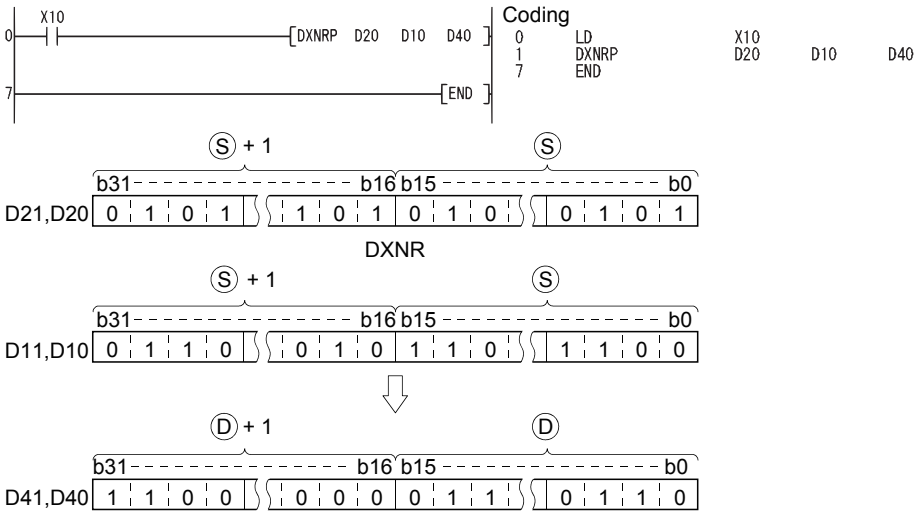
The execution conditions for exclusive NOR instructions are as follows.



◆Program example

DXNR

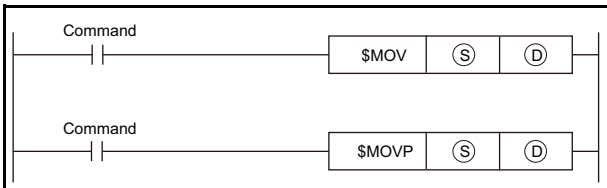
- The following program performs an exclusive NOR operation on the 32-bit data at D20 and D21 and the data at D10 and D11 when X10 is turned ON, and stores the result to D40 and D41.



3.30 Display instruction

3.30.1 Character string data transfer ... $MOV, $MOVP

	Applicable device									Digit specification	Error flag
	Bit device			Word (16-bit) device			Constant		Level		
	X	Y	M	T	C	D	K	H	N		(SM0)
Ⓓ				○	○	○					○

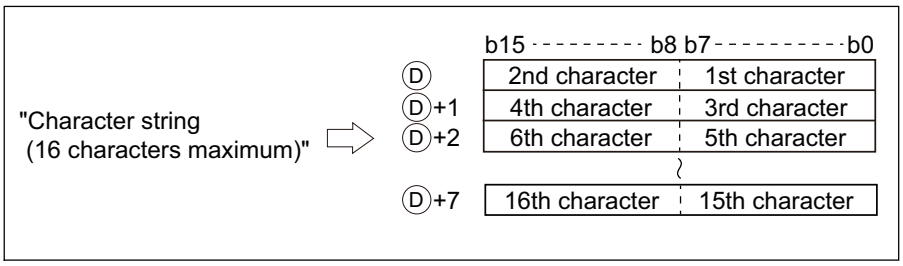


Setting data

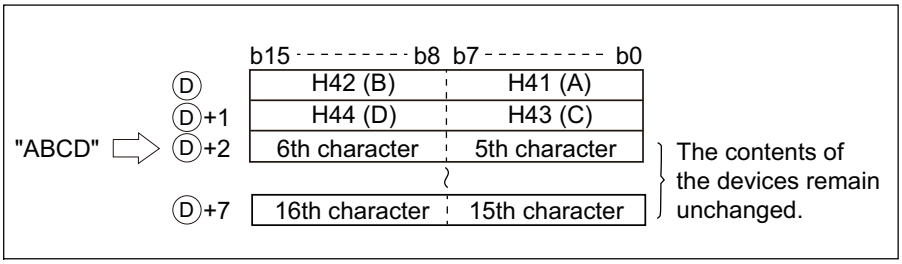
Ⓢ	Transferred character string (Maximum character string: 32 characters (up to 16 characters can be transferred))
Ⓓ	Start number of the device in which the ASCII code is stored

◆Function

- The character string data enclosed in double-quotation marks (" ") specified with Ⓢ are transferred after the device number specified in Ⓓ.
- Only character string data that is enclosed in double-quotation marks (" ") can be set in Ⓢ. A device can also be input, but doing so results in an error at execution (INSTRCT. CODE ERR: 4000).
- Only word devices can be set in Ⓓ. Bit devices can also be input, but doing so results in an error (INSTRCT. CODE ERR: 4000) at execution.
- A maximum of 32 characters can be set in Ⓢ. (Up to 16 characters can be transmitted from Ⓢ to Ⓓ. The 17th character or later are invalid.)


"Character string
(16 characters maximum)"
b15 b8 b7 b0
Ⓓ 2nd character 1st character
Ⓓ+1 4th character 3rd character
Ⓓ+2 6th character 5th character
Ⓓ+7 16th character 15th character

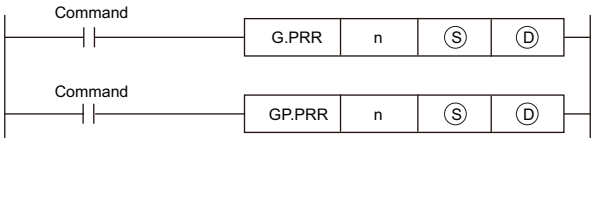
- If the set number of characters is less than 16, the content of Ⓓ in the sections without corresponding characters remains unchanged.


"ABCD"
b15 b8 b7 b0
Ⓓ H42 (B) H41 (A)
Ⓓ+1 H44 (D) H43 (C)
Ⓓ+2 6th character 5th character
Ⓓ+7 16th character 15th character
The contents of the devices remain unchanged.

3.30.2 Character string output ... G. PRR, GP.PRR, UMSG

G.PRR, GP.PRR

	Applicable device									Others U	Digit specification	Error flag
	Bit device			Word (16-bit) device			Constant		Level			
	X	Y	M	T	C	D	K	H	N			(SM0)
n										○		
Ⓢ				○	○	○						○
Ⓓ	○	○	○			○						



Setting data

n	Not used, but U is specified
Ⓢ	Character string that is displayed on the display unit or the start number of the devices containing the character string to be displayed
Ⓓ	Not used, but Y is specified

UMSG

	Applicable device									Digit specification	Error flag
	Bit device			Word (16-bit) device			Constant		Level		
	X	Y	M	T	C	D	K	H	N		(SM0)
Ⓢ				○	○	○					○

Setting data

Ⓢ	Character string that is displayed on the display unit or the start number of the devices containing the character string to be displayed

◆Function

G.PRR, GP.PRR

n is not used, but specify U.

Register the data to be displayed on the LCD operation panel (FR-LU08) or the parameter unit (FR-PU07) in the device specified with Ⓢ.

Ⓓ is not used, but specify Y.

UMSG

Register the data to be displayed on the LCD operation panel (FR-LU08) or the parameter unit (FR-PU07) in the device specified with Ⓢ.

◆Setting data: For user monitor name

Set the monitor name as shown below when SD1216 to 1218 are monitored by the LCD operation panel (FR-LU08) or the parameter unit (FR-PU07).

	Upper 8 bits	Lower 8 bits	
Ⓢ+0	****	01	←Set the corresponding monitor number to the upper 8 bits, and 01 to the lower 8 bits.
	2nd character	1st character	←Monitor name: Character start
	4th character	3rd character	
	6th character	5th character	
	8th character	7th character	
	10th character	9th character	
	12th character	11th character	
	14th character	13th character	
Ⓢ+8	16th character	15th character	

- Set 01 to the lower 8 bits of Ⓢ+0.
- Set the monitor description number to replace the user monitor name display in the upper 8 bits of Ⓢ+0.
  The monitor description number is as shown below.

Monitor description number	Monitor description
40	User monitor 1: SD1216 description
41	User monitor 2: SD1217 description
42	User monitor 3: SD1218 description

- When the upper 8 bits of Ⓢ+0 are values other than those in the table above, an operation error (OPERATION ERROR: 4100) is generated.
- When the 7th bit of Ⓢ+0 is executed as 1 (lower 8 bits as H81), the registered data is cleared and the monitor display returns to normal.
- Settings can be made up to the 16th character. (Data from Ⓢ+1 to Ⓢ+8 are effective as characters.)
- Up to 12 characters can be displayed on the FR-LU08 or the FR-PU07. When the number of characters exceeds 12, the 13th character or later will not appear.

NOTE

- To display the monitor above on the parameter unit (FR-PU07), set "40, 41, 42" in **Pr.774 to Pr.776** in advance. (For details on **Pr.774 to Pr.776**, refer to **the Instruction Manual (Detailed)** of the inverter.)

◆Setting data: For user-defined error name

Set the user-defined error name as shown below to display the user-defined error on the LCD operation panel (FR-LU08) or the parameter unit (FR-PU07). (A user defined error occurs when values 16 to 20 are set in SD1214.)

	Upper 8 bits	Lower 8 bits	
Ⓢ+0	****	02	←Set the corresponding error number to the upper 8 bits, and 02 to the lower 8 bits.
	2nd character	1st character	←Error name: Character start
	4th character	3rd character	
	6th character	5th character	
	8th character	7th character	
	10th character	9th character	
	12th character	11th character	
	14th character	13th character	
Ⓢ+8	16th character	15th character	

- Set an error number that corresponds to the upper 8 bits of Ⓢ+0. The setting range is from 16 to 20.
- When the upper 8 bits of Ⓢ+0 are values other than 16 to 20, an operation error (OPERATION ERROR: 4100) is generated.
- When the 7th bit of Ⓢ+0 is executed as 1 (lower 8 bits as H82), the registered data is cleared.
- Settings can be made up to the 16th character. (Data from Ⓢ+1 to Ⓢ+8 are effective as characters.)
- Up to 12 characters can be displayed on the FR-LU08 or the FR-PU07. When the number of characters exceeds 12, the 13th character or later will not appear.

◆Setting data: For user parameter name

Set the parameter name as shown below to display the read user parameters **Pr.1150 to Pr.1159** on the LCD operation panel (FR-LU08).

	Upper 8 bits	Lower 8 bits	
(S)+0	****	03	←Set the corresponding parameter number to the upper 8 bits, and 03 to the lower 8 bits.
	2nd character	1st character	←Parameter name: Character start
	4th character	3rd character	
	6th character	5th character	
	8th character	7th character	
	10th character	9th character	
	12th character	11th character	
	14th character	13th character	
(S)+8	16th character	15th character	

- Set the corresponding parameter number the upper 8 bits of (S)+0.

Parameter number	Setting value
1150	01
1151	02
1152	03
1153	04
1154	05
1155	06
1156	07
1157	08
1158	09
1159	10

- When the upper 8 bits of (S)+0 are values other than those in the table above, an operation error (OPERATION ERROR: 4101) is generated.
- When the 7th bit of (S)+0 is executed as 1 (lower 8 bits as H83), the registered data is cleared.
- Settings can be made up to the 16th character. (Data from (S)+1 to (S)+8 are effective as characters)
- Up to 9 characters can be displayed on the FR-LU08. When the number of characters exceeds 9, the 10th character or later will not appear.

◆Setting data: For unit names

This function sets up the increment for the user monitors SD1216 to SD1218 or the user parameters **Pr.1150 to Pr.1159** using the LCD operation panel (FR-LU08) or the parameter unit (FR-PU07).

	Upper 8 bits	Lower 8 bits	
Ⓢ+0	****	04	← Set the corresponding user monitor number to the upper 8 bits, and 04 to the lower 8 bits.
	2nd character	1st character	← Unit name: Character start
Ⓢ+2		3rd character	

- Set 04 to the lower 8 bits of Ⓢ+0.
- To replace the unit displayed, set the number corresponding to the target monitor or parameter in the upper 8 bits of Ⓢ+0.
  Numbers that can be specified are shown in the following table.

Number of unit name	Item to add unit
01	Unit corresponding to **Pr.1150**
02	Unit corresponding to **Pr.1151**
03	Unit corresponding to **Pr.1152**
04	Unit corresponding to **Pr.1153**
05	Unit corresponding to **Pr.1154**
06	Unit corresponding to **Pr.1155**
07	Unit corresponding to **Pr.1156**
08	Unit corresponding to **Pr.1157**
09	Unit corresponding to **Pr.1158**
10	Unit corresponding to **Pr.1159**
40	User monitor 1: Unit corresponding to the description of SD1216
41	User monitor 2: Unit corresponding to the description of SD1217
42	User monitor 3: Unit corresponding to the description of SD1218

- When the upper 8 bits of Ⓢ+0 are values other than those in the table above, an operation error (OPERATION ERROR: 4100) is generated.
- When the 7th bit of Ⓢ+0 is executed as 1 (lower 8 bits as H84), the registered data is cleared.
- Settings can be made up to the 3rd character. (Ⓢ+1 to Ⓢ+2: Data up to the lower 8 bits are effective as characters.)

◆Quantity that can be set

Setting data	Quantity
User monitor (Refer to **page 194**)	Up to 3*1
User definition error (Refer to **page 194**)	Up to 5*1
User parameter (Refer to **page 195**)	Up to 10*1
Unit name (Refer to **page 196**)	Up to 13*1

*1 If any of the setting quantities is exceeded, an operation error (OPERATION ERROR: 4100) occurs at the point when the exceeded setting is executed. Furthermore, an operation error (OPERATION ERROR: 4100) also occurs if the lower 8 bits of Ⓢ+0 are set to values other than 01 to 04, or H81 to H84.

NOTE

- An error does not occur even if the stored data exceeds the range of the corresponding device, but the content of devices outside of the range is changed. When storing data, check beforehand that the amount of devices required for storage can be allocated.
- Do not change any of the device data while it is being displayed because the data stored in the device is used in actual communication. Changing such data will change the transmitted data.
- If the ASCII data is other than 0x20 to 0x7A that can be displayed on the FR-LU08 or the FR-PU07, it can be replaced with 0x20 (space).
- [^] (H5E), [_] (H5F) and ['] (H60) cannot be displayed by the FR-PU07.

4 Error code list

4.1 How to read error codes..... 198

If an error occurs when PLC function is RUN or during RUN, an error indication is generated by the self-diagnostic function, and an error code and error step are stored in the special register. The error description and corrective action are as follows:

4.1 How to read error codes

When an error occurs, the error code can be read using a peripheral device.
For details on the operation method, refer to the operating manual of the peripheral device.
The error code, error name, error description possible cause, and corrective actions are as follows.
Error codes are stored in SD0, and the error steps are stored in SD4 to SD26.

Error code (SD0)	Error name	Error description possible cause	Corrective action
1010	END NOT EXECUTE	All programs in the program capacity are executed without executing the END instruction. • After the END instruction was executed, a different instruction code was read due to noise, etc. • The END instruction has changed to a different instruction code for some reason.	• Take measures against noise. • Perform an inverter reset and go to the RUN state again. • If the same error is displayed again, a CPU hardware error has occurred. Please contact your sales representative and explain the failure symptom.
2200	MISSING PARA.	• There are no parameter files.	• Set a parameter file.
2502	CAN'T EXE. PRG.	• The program file is not correct, or the content of the file is not a program.	• Check that the program file type is ***.QPG, and check that the file content is a program.
3000	PARAMETER ERROR	• The content of the parameter indicated by the error individual information (SD16) is incorrect.	• Read the error individual information with a programming tool, check the parameter items that correspond to the values (parameter number) and correct them. • Re-write the corrected parameters, reset the power or reset the inverter. • If the same error is displayed again, a CPU hardware error has occurred. Please contact your sales representative and explain the failure symptom.
3003	PARAMETER ERROR	• The number of device points set in the PLC parameter device setting is not within the usable range.	• Read the error individual information with a programming tool, check the parameter items that correspond to the values (parameter number) and correct them. • If the error occurs again after correcting the parameter, a memory error has occurred in the program memory. Please contact your sales representative and explain the failure symptom.
4000	INSTRCT. CODE ERR	• An undecodable instruction code is included in the program. • An unusable instruction is included in the program.	• Read the common error information with a programming tool, check the error step that corresponds to the value (program error location) and correct it.
4010	MISSING END INS.	• No END (FEND) instruction in the program.	• Read the common error information with a programming tool, check the error step that corresponds to the value (program error location) and correct it.
4100	OPERATION ERROR	• Data that cannot be used in instructions is included.	• Read the common error information with a programming tool, check the error step that corresponds to the value (program error location) and correct it.

Error code (SD0)	Error name	Error description possible cause	Corrective action
5001	WDT ERROR	• The program scan time exceeded the watchdog timer value set in the PLC RAS setting of the PLC function parameter.	• Read the error individual information with the programming tool, check the values (time) and shorten the scan time. • Change the initial execution monitoring time or watchdog setting values with the PLC RAS settings of the PLC function parameter. • Delete the infinite loop from the jump transition. • Check the number of executions of the interrupt program with a programming tool, and reduce the number of interrupt occurrences.
5010	PRG. TIME OVER	• The program scan time exceeded the constant scan time set in the PLC RAS setting of the PLC function parameter.	• Review the constant scan time setting. • Review the PLC parameter constant scan time and low-speed program execution time in order to secure sufficient remaining time for the constant scan.

MEMO

APPENDIX

Appendix 1 Instruction processing time 202

Appendix 1 Instruction processing time

◆Basic instructions

◆Sequence instructions

Classification	Instruction	Condition (device)	Processing time (μs)
Contact	LD		1.9
	LDI		1.9
	AND		1.9
	ANI		1.9
	OR		2.0
	ORI		2.0
Link	ORB		1.3
	ANB		1.3
	MPS		1.4
	MRD		1.4
	MPP		1.4
Output	OUT	Y,M,SM	2.4
	OUT	T	7.6
	OUT	C	7.9
	SET	Y,M,SM	2.6
	RST	Y,M,SM	2.6
	RST	T	9.2
	RST	C	10.0
	RST	D	4.3
	PLS		3.4
	PLF		3.4
Shift	SFT		3.4
	SFTP		4.2
Master control	MC		3.8
	MCR		1.3
Program end	END,FEND		0.8
Non-processing	NOP		1.3

◆Comparison operation instructions

Classification	Instruction	Condition (device)	Processing time (μs)	
			Subset *1	Other than subset
BIN 16-bit data comparison	LD=	S1 S2	8.0	9.9
	LD<>	S1 S2	8.0	9.9
	LD<	S1 S2	8.0	9.9
	LD>	S1 S2	8.0	9.9
	LD<=	S1 S2	8.1	10.0
	LD>=	S1 S2	8.1	10.0
	AND=	S1 S2	8.2	9.6
	AND<>	S1 S2	8.2	9.7
	AND<	S1 S2	8.4	9.8
	AND>	S1 S2	8.3	9.7
	AND<=	S1 S2	8.3	9.7
	AND>=	S1 S2	8.3	9.7
	OR=	S1 S2	8.7	9.8
	OR<>	S1 S2	8.6	9.8
	OR<	S1 S2	8.6	9.8
	OR>	S1 S2	8.6	9.8
	OR<=	S1 S2	8.8	9.9
	OR>=	S1 S2	8.8	9.9
BIN 32-bit data comparison	LDD=	S1 S2	8.8	11.1
	LDD<>	S1 S2	8.8	11.1
	LDD<	S1 S2	8.8	11.1
	LDD>	S1 S2	8.8	11.1
	LDD<=	S1 S2	8.8	11.1
	LDD>=	S1 S2	8.8	11.1
	ANDD=	S1 S2	9.2	11.0
	ANDD<>	S1 S2	9.2	11.0
	ANDD<	S1 S2	9.2	11.0
	ANDD>	S1 S2	9.2	11.0
	ANDD<=	S1 S2	9.2	11.0
	ANDD>=	S1 S2	9.2	11.0
	ORD=	S1 S2	9.4	9.9
	ORD<>	S1 S2	9.4	9.9
	ORD<	S1 S2	9.4	9.9
	ORD>	S1 S2	9.4	9.9
	ORD<=	S1 S2	9.4	9.9
	ORD>=	S1 S2	9.4	9.9

◆Arithmetic operation instructions

Classification	Instruction	Condition (device)	Processing time (µs)	
			Subset *1	Other than subset
BIN 16-bit addition/ subtraction	+	S D	8.4	13.5
	+P	S D	11.0	14.3
	-	S D	8.4	13.5
	-P	S D	11.0	14.3
	+	S1S2 D	8.4	13.6
	+P	S1S2 D	11.0	14.5
	-	S1S2 D	8.4	13.6
	-P	S1S2 D	11.0	14.5
BIN 32-bit addition/ subtraction	D+	S D	9.6	15.6
	D+P	S D	12.0	16.4
	D-	S D	9.6	15.6
	D-P	S D	12.0	16.4
	D+	S1S2 D	9.6	15.7
	D+P	S1S2 D	12.0	16.5
	D-	S1S2 D	9.5	15.7
	D-P	S1S2 D	12.0	16.5
BIN 16-bit multiplication /division	*	S1S2 D	8.7	13.9
	*P	S1S2 D	11.2	14.7
	/	S1S2 D	8.9	14.2
	/P	S1S2 D	11.5	15.0
BIN 32-bit multiplication /division	D*	S1S2 D	9.7	15.7
	D*P	S1S2 D	12.2	16.5
	D/	S1S2 D	10.1	15.9
	D/P	S1S2 D	12.6	16.7
Data increment/ decrement	INC	D	5.8	11.1
	INCP	D	7.6	11.8
	DEC	D	5.8	11.1
	DECP	D	7.6	11.9
	DINC	D	6.5	12.6
	DINCP	D	8.2	13.4
	DDEC	D	6.5	12.6
	DDECP	D	8.2	13.4

◆Data transfer instructions

Classification	Instruction	Condition (device)	Processing time (µs)	
			Subset *1	Other than subset
16-bit transfer	MOV		5.8	13.5
	MOVP		7.6	14.2
32-bit transfer	DMOV		6.4	15.6
	DMOVP		8.3	16.4

◆Data conversion instructions

Classification	Instruction	Condition (device)	Processing time (µs)	
			Subset *1	Other than subset
2's complement	NEG	D	8.8	11.1
	NEGP	D	9.5	11.8
	DNEG	D	8.8	12.6
	DNEGP	D	9.6	13.4
BCD conversion	BCD	S D	5.8	13.7
	BCDP	S D	8.3	14.5
	DBCD	S D	7.8	16.9
	DBCDP	S D	9.6	17.7
BIN conversion	BIN	S D	5.9	13.7
	BINP	S D	7.6	14.6
	DBIN	S D	6.8	16.1
	DBINP	S D	8.5	16.9

*1 When all the devices used in the instruction satisfy one of the following conditions, they are regarded as a subset.
- All the devices used are word devices.
- When the devices used are bit devices, the specified number of bits is the multiple of 16, or the digits are specified as K4 (word data) or K8 (double word data).
- The devices used are constants.

NOTE

- During inverter control, reading 1000 steps takes a scan time of about 40 ms.

◆Application instructions

◆Logical operation instructions

Classification	Instruction	Condition (device)	Processing time (μs)	
			Subset *1	Other than subset
Logical OR	WOR	S D	8.6	13.6
	WORP	S D	11.2	14.4
	WOR	S1 S2 D	8.6	13.6
	WORP	S1 S2 D	11.2	14.4
	DOR	S D	9.7	15.7
	DORP	S D	12.2	16.5
	DOR	S1 S2 D	9.7	15.7
	DORP	S1 S2 D	12.2	16.5
Logical AND	WAND	S D	8.6	13.6
	WANDP	S D	11.2	14.4
	WAND	S1 S2 D	8.6	13.6
	WANDP	S1 S2 D	11.2	14.4
	DAND	S D	9.7	15.7
	DANDP	S D	12.2	16.5
	DAND	S1 S2 D	9.7	15.7
	DANDP	S1 S2 D	12.2	16.5
Exclusive OR	WXOR	S D	8.6	13.6
	WXORP	S D	11.2	14.4
	WXOR	S1 S2 D	8.6	13.6
	WXORP	S1 S2 D	11.2	14.4
	DXOR	S D	9.7	15.7
	DXORP	S D	12.2	16.5
	DXOR	S1 S2 D	9.7	15.7
	DXORP	S1 S2 D	12.2	16.5
Exclusive NOR	WXNR	S D	8.6	13.6
	WXNRP	S D	11.2	14.4
	WXNR	S1 S2 D	8.6	13.6
	WXNRP	S1 S2 D	11.2	14.4
	DXNR	S D	9.7	15.7
	DXNRP	S D	12.2	16.5
	DXNR	S1 S2 D	9.7	15.7
	DXNRP	S1 S2 D	12.2	16.5

◆Instructions regarding the message display on PU

Classification	Instruction	Condition (device)	Processing time (μs)
Character string data transfer	$MOV		12.6
	$MOVP		13.3
Character string output	G.PRR		8.7
	GP.PRR		9.6
	UMSG		5.3

*1 When all the devices used in the instruction satisfy one of the following conditions, they are regarded as a subset.
- All the devices used are word devices.
- When the devices used are bit devices, the specified number of bits is the multiple of 16, or the digits are specified as K4 (word data) or K8 (double word data).
- The devices used are constants.

NOTE

- During inverter control, reading 1000 steps takes a scan time of about 40 ms.

MEMO

REVISIONS

*The manual number is given on the bottom left of the back cover.

Print date	*Manual number	Revision
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